POPULAR SCIENCE Monthly

June 1949

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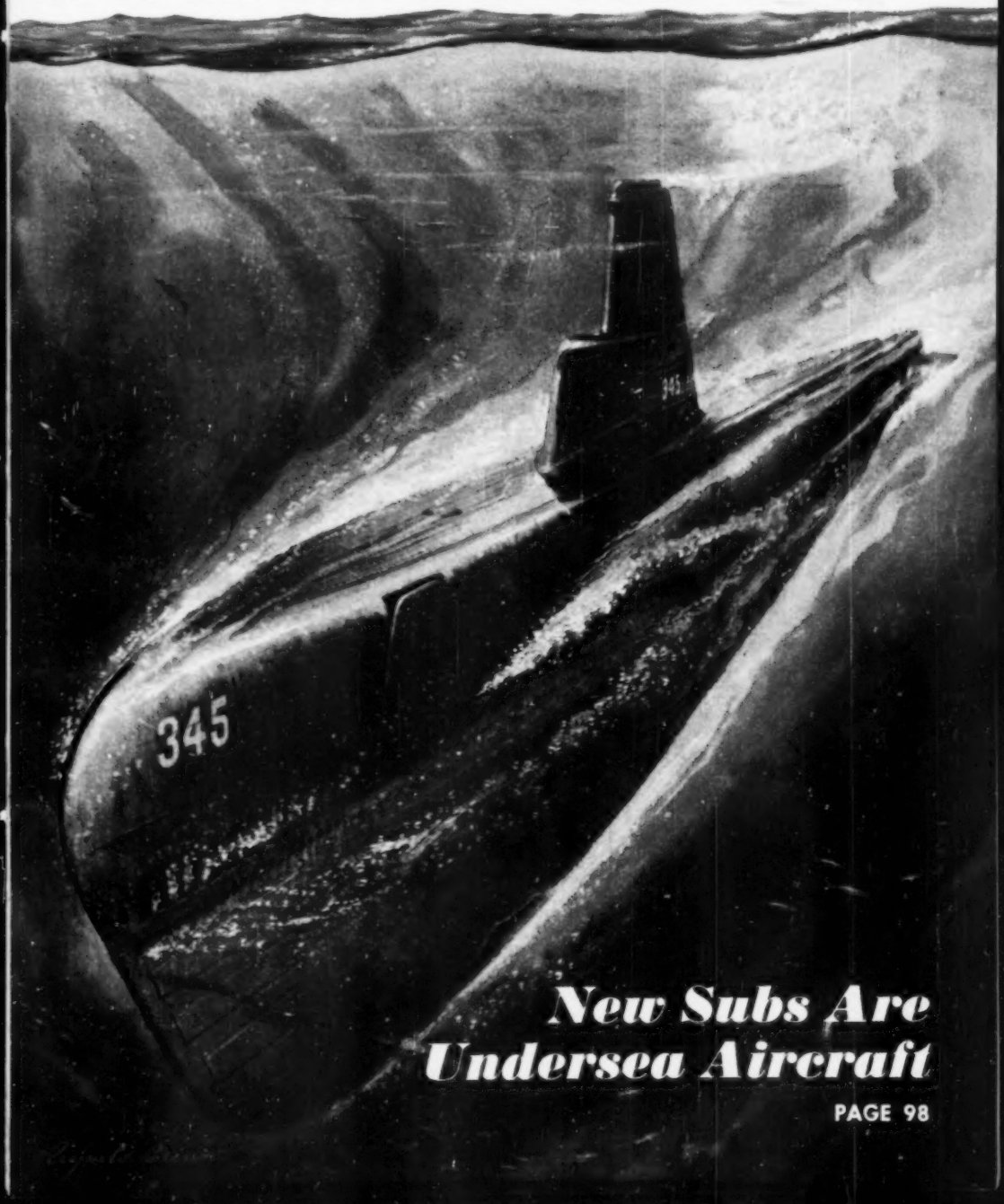

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PAGE 98

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POPULAR SCIENCE

MECHANICS AND HOUSEHOLD Monthly

JUNE, 1949

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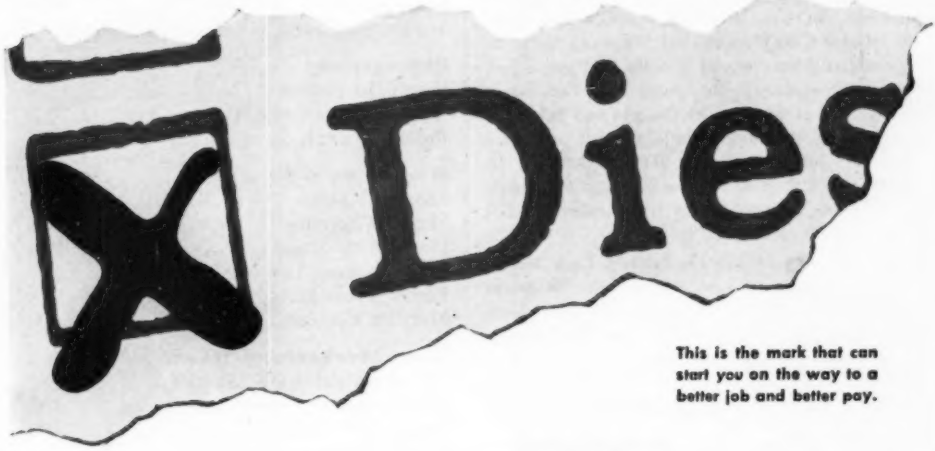
This mark brought income



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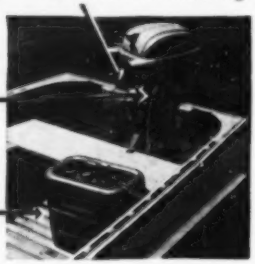

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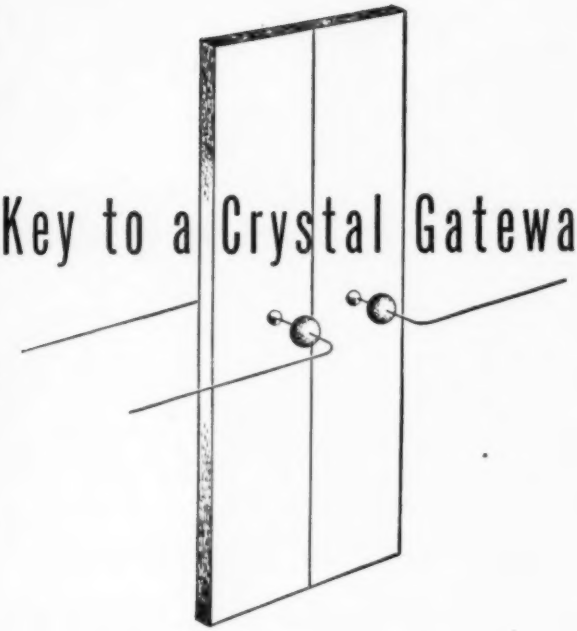
Above is a coaxial circuit crystal in its glass enclosure. At right the crystal is shown, 3¼ times actual size, with connecting wires soldered in position. Weights on wires reflect energy back into crystal, so cut losses.

Key to a Crystal Gateway



How would you solder a wire to a crystal? This must be done for most of those wafer-thin plates of quartz used in electrical circuits. They play a big part in the myriad-channel telephone system that utilizes coaxial cables.

This is how Bell Laboratories scientists solved the problem: A spot of paste containing silver is deposited on the crystal and bonded to it by oven heat. The crystal is then vapor-plated with a thin layer of silver. Then a fine wire is soldered to the spot by a concentrated blast of hot air. The result is a rugged electrical connection to the surface of the crystal which does not interfere with its vibrations.

Sealed in glass tubes, the crystals are precise and reliable performers in the telephone system. Each is a crystal gate to a voiceway, separating *your* conversation from the hundreds of others which may be using a pair of coaxial conductors, at the same time.

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It is time you realized that the rites, rituals and practices of the ancients were not superstitions, but subterfuges to conceal the marvelous workings of natural law from those who would have misused them. Telepathy, projection of thought, the materializing of ideas into helpful realities, are no longer thought by intelligent persons to be impossible practices, but instead, *demonstrable sciences,* by which a greater life of happiness may be had.

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Letters

PS Solves a Mystery

Sir:

In the rear of the M.I.T. grounds, between two of the war-born radiation laboratories, stands a dirty, deserted house, bearing the sign, "BUILDING 34." The roof is recessed and covered with tar paper and a large sheet of canvas. Through the windows can be seen a litter of old furniture and the usual accumulation of equipment found in any "Tech" building. . . . No one seemed to know what it was; it was our ghost building.

The March issue of PS came, and all our problems were solved. The picture at top of page 112 is our mysterious "BUILDING 34." I want to take this opportunity to thank your editors for revealing one of M.I.T.'s deepest secrets, and urge you on to an even more important mission—find out what goes on in our "BUILDING 18."

STANLEY J. SOLOMON
Massachusetts Institute of Technology
Boston, Mass.

It's the shower room.

Ice—But No Slip

Sir:

I found your article "Oil Well Nuisance Becomes Dry Ice" (PS, April '49, p. 164) very interesting and informative. What I would like to know is how you figured that 1,155 cakes of dry ice weighed 69,000 lb.

You stated: "Snow, obtained by releasing pressure on liquid carbon dioxide is compressed into 240-lb. dry-ice cakes by hydraulic press." In turn these cakes of dry ice are cut by two bandsaws. If two bandsaws made a single cut on each block, there would be three eighty-pound blocks. Right? The freight car holds 1,155 cakes and the total weight is 69,000 lb.

If 1,155 cakes of dry ice weigh 80 lb. each, the total weight would be 92,400 lb. as I figure it. What happened to the remaining 23,400 lb? Did it evaporate or was it lost in "saw dust?"

R. L. STINEROCK
Albert Lea, Minn.

The answer here is that the two saws

WHAT Every AUTO MECHANIC Wants to Know

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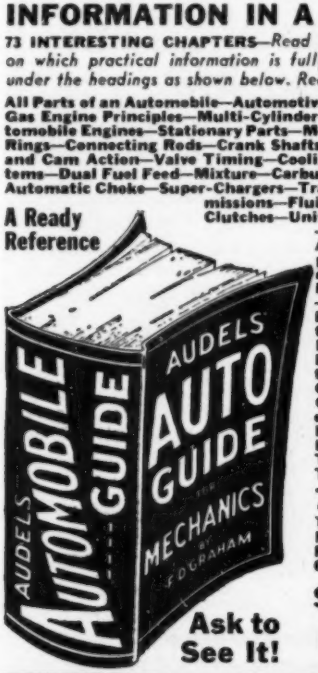

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quarter the blocks, one cutting them in half lengthwise and the other cutting them in half crosswise. Thus each large block is cut into four, not three, smaller ones, each weighing 60 pounds. Multiply this weight times 1,155, the number of blocks that the car will hold, and you'll get the same figure PS did—roughly 69,000 pounds.*

Long Conveyer

Sir:

We were very interested to read in your magazine (March 1949 issue, page 117) details of a belt conveyer operating at Storrs Colliery, near Scranton, Pa.

We feel sure that you will be interested in hearing that there is in operation at a British colliery a belt conveyer made by us 5,715 feet in length. Thus the belt is 11,430 ft. long. This conveyer operates down a slight incline of 2½° and handles 1,800 tons of coal per day. The prime mover of this conveyer is an electric motor of 100 hp.

W. F. G. SUTCLIFFE
Director & General Manager
Richard Sutcliffe Ltd.
London, England.

Friendly Squealer

Sir:

On page 129 of the March issue of your publication appeared an illustration with an 11-line caption pertaining to the Tachograph, a product distributed nationally by the Wagner Electric Corporation. This caption—reading in part as follows, 'Pet peeve of long-haul trucker is mechanical "squealer" staring at him from top of dashboard. This gimmick keeps record for home office of freighter's mileage, speed, time on road, length of stops.'—is a little less than fair.

It seems to us that the originator of this article has been just a little hasty in forming and writing the opinion expressed. Far from being a "squealer" this unit has proved to be a protection to the driver on many an occasion. . . .

L. C. DOBRUNZ
Sales Promotion Manager
Wagner Electric Corporation
St. Louis, Mo.

Overboard for Overdrive

Sir:

I would like to say "Thanks" in block type

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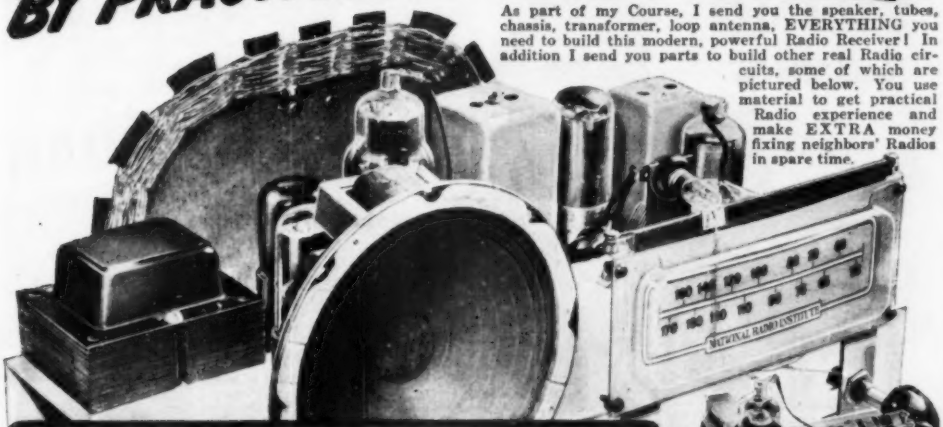

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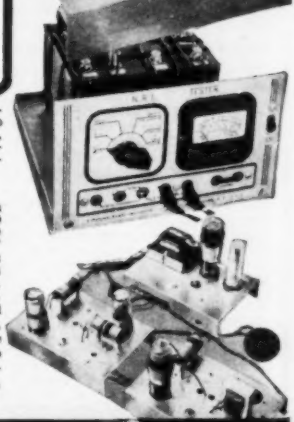

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about six feet high for your most interesting and thoroughly clear article in the current issue [PS, April '49, p. 180], "How Overdrive Works." As you say, Bill Barnes certainly makes it easy to follow, and with the clean-cut line drawings, it clicks, but quick.

I've been driving an overdrive-equipped Chrysler Imperial continuously now for over 12 years, a 1937 model, and while I knew in a way what happened down there under the floor boards, I never was quite able to really "see" what went on, until I read this story. Now I've got it, and got it right.

CHARLES CULVER

Toronto, Canada

Don't Skid Around

Sir:

Stop them before they kill somebody! I refer to the Hydraulic Ratio Changer described in your February issue (page 192). . . . Locked rear wheels are many times more likely to cause a skid than locked front wheels . . .

ELDRED F. TUBBS

Pittsburgh, Pa.

Yes, but if you avoid the clutch and use the brakes moderately, as you should on ice, you're much more likely to lock the front wheels—because the engine keeps turning the rear ones. PS skidded in letting the artist show a passenger car. The Wagner Ratio Changer is for trucks. When experienced truck drivers apply brakes on skiddy surfaces, the motor-driven rear wheels aren't likely to lock, but the unpowered front ones may. Locked, they lose their steering grip and deprive the driver of control. The Ratio Changer reduces the likelihood of locking the front wheels.

It Was a Good Car

Sir:

When you write an article on sports automobiles and don't mention the 1937 Cord supercharged front-wheel drive, you have made an omission worth mention.

This car, which was made in the U. S. 12 years ago, certainly deserves prominent mention wherever thoroughbred automobiles are discussed. It was a rare combination of racing car and fine coach work and excelled in both. Its 178-horsepower, V-8 engine, 4-speed transmission, and front-wheel drive combined to set a number of records that

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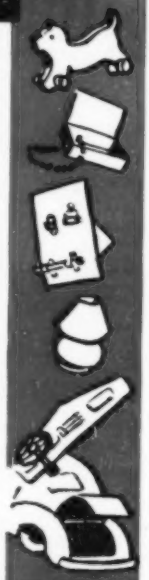

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T. J. Arneson, Jr.
Professional Instruments Co.
Minneapolis, Minn.

We agree with what you say, but most sports-car enthusiasts consider the Cord a stock car, rather than a true sports car.

Eggs-cuse Us, Please

Sir:

On your April cover the Kaiser Traveler has a load that would do credit to a pick-up truck. One part of the load evidently is intended to be a case of eggs. What are those, ostrich eggs? The case label says, "12 doz." Methinks our friend in the checked shirt has been robbed. I've handled over 200,000 dozen eggs in that type of case in the past 2½ years, and all those I've seen held 30 dozen to the case. However, that's a very minor error.

I considered Devon Francis' work on the Kaiser feature and on the new Chrysler lines tops. Both were well written and, above all, well illustrated—much better coverage on the Chrysler feature than some of your competitors did.

So keep it up, but better count your eggs before they're illustrated.

Clifford Schwab
Jonesville, Mich.

Even the artist, who handled egg crates in his youth, slipped on this one.

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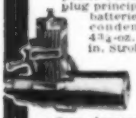

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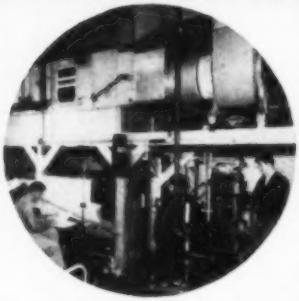

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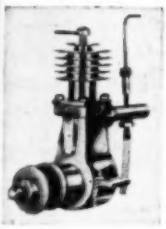

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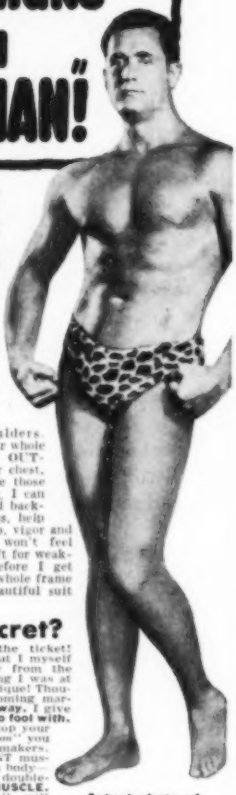

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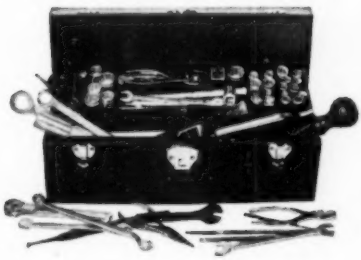

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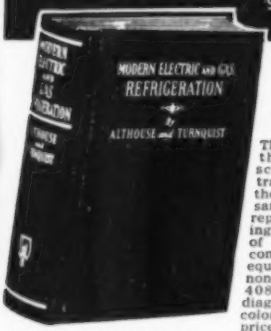

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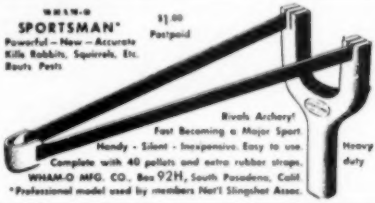

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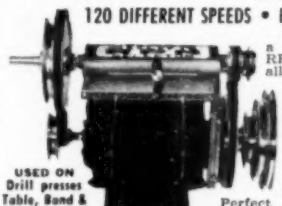

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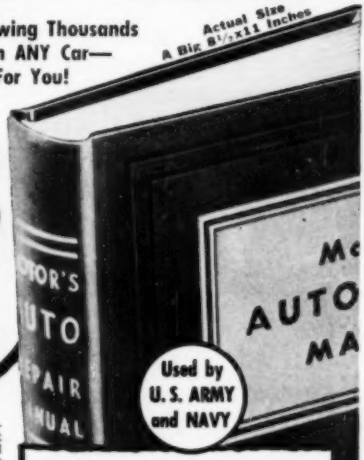

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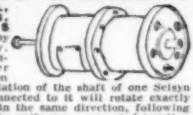

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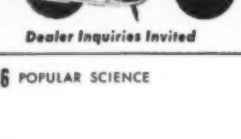

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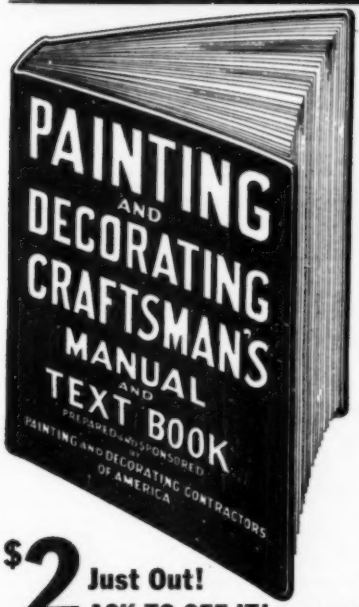

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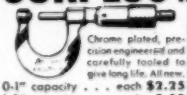

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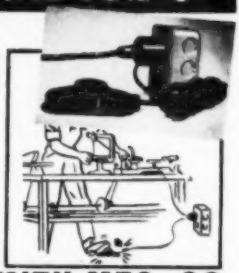

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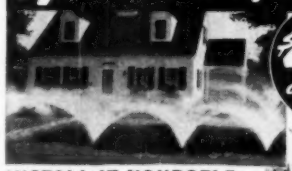

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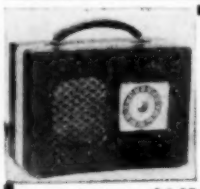

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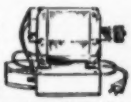

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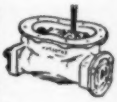

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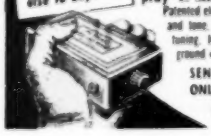

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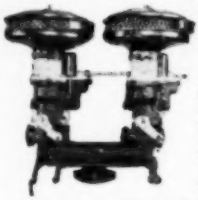

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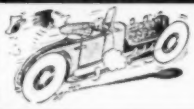

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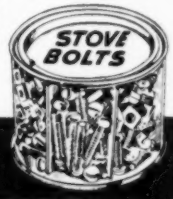

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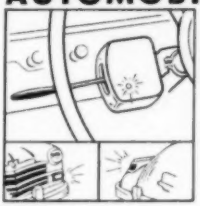

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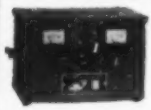

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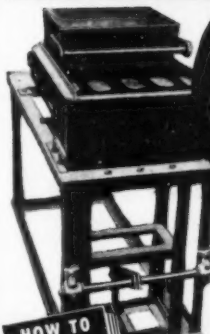

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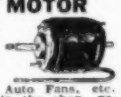

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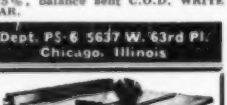

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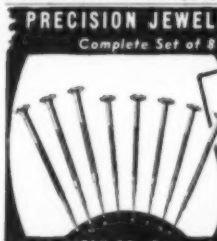

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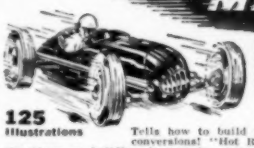

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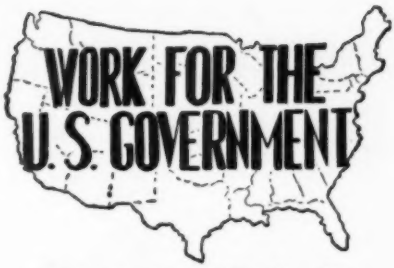

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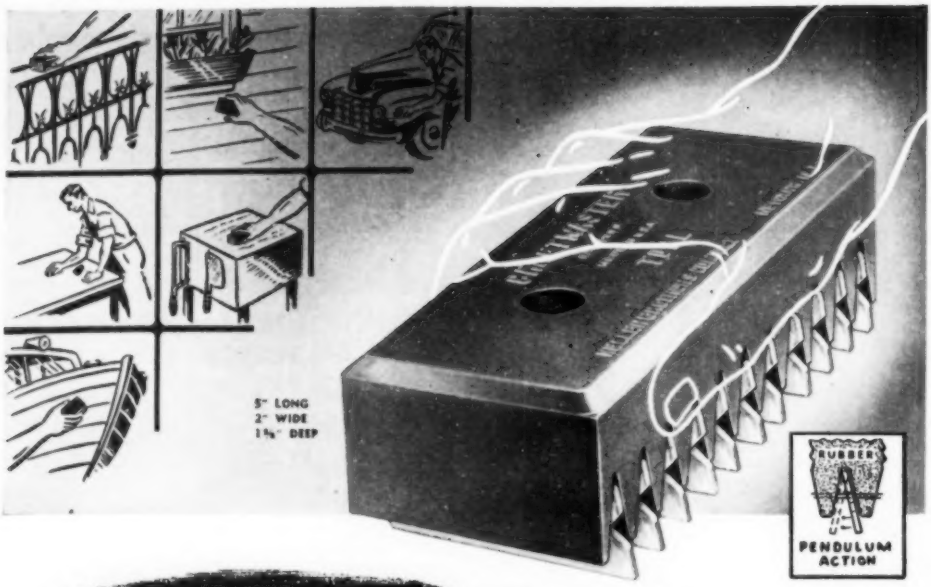

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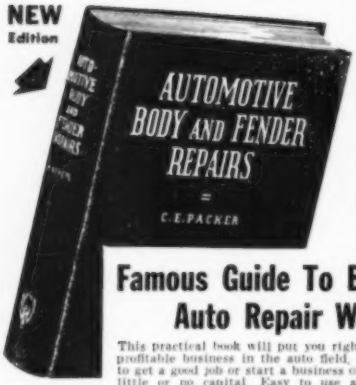

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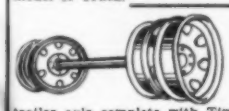

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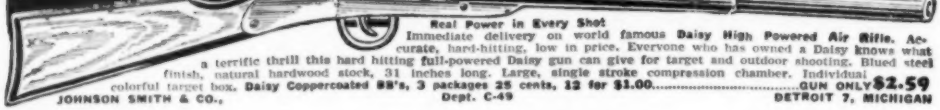

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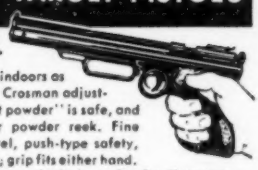

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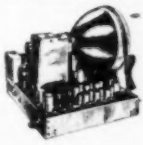

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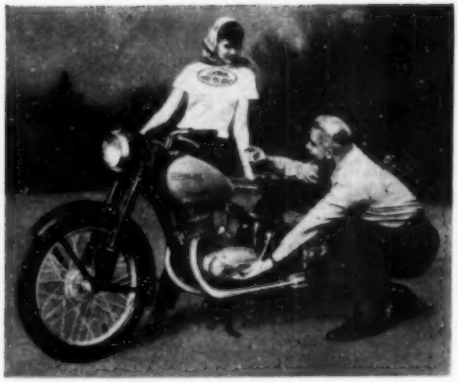

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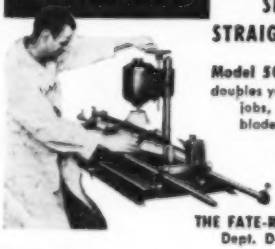

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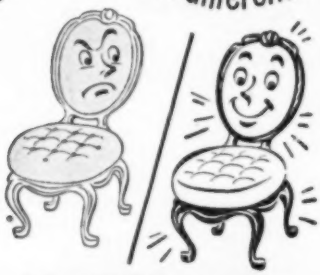

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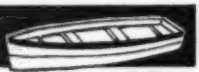

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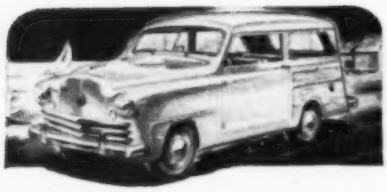

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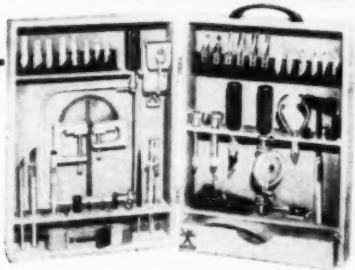

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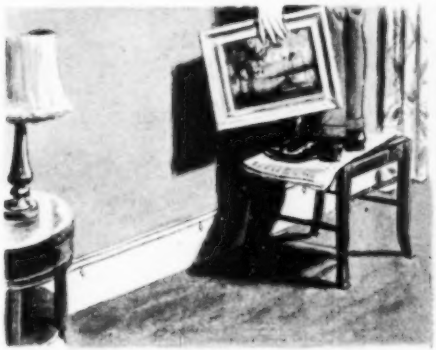
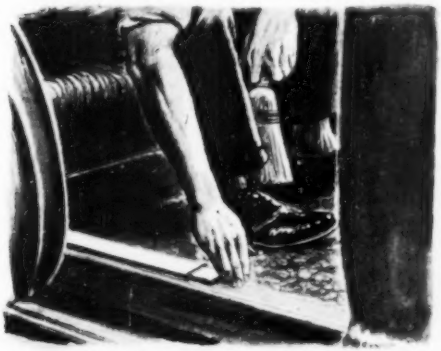
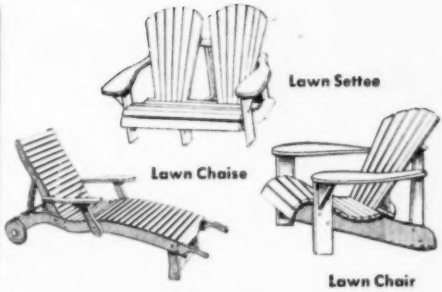


Markers for stud locations. These could be a decorative design along the baseboard or nails with decorative heads. With each stud marked, it'd be a cinch to find one to hang a picture or mirror.—*Reade Transue, Easton, Pa.*



Telescoping doorsills in cars. Sweeping the last bit of dust from a floor mat is always tough because of the raised sill. A sliding section could be pushed aside to let you really clean the mat.—*R. Durney, Cleveland, O.*



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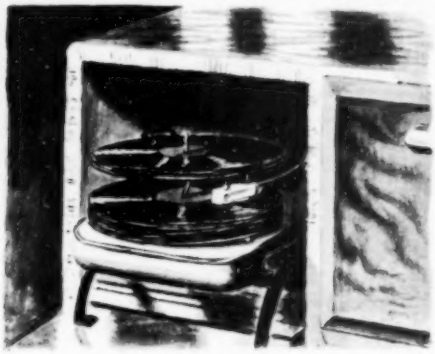
I'd like to see them make . . .

Metal refrigerator dishes. These could be taken from the refrigerator and set directly on the stove to warm up leftovers. A detachable handle could be used to remove them from the range.—*Mrs. Phil Aarestad, Williston, N. D.*



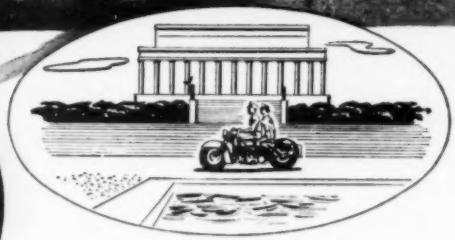
Emergency stops for record players. A switch on the top of the pickup arm would stop the machine if the mechanism accidentally dropped a record on the arm while the machine was playing.—*Robert Burroughs, Terre Haute, Ind.*

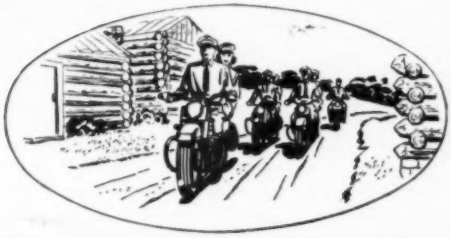
Alarms on dashboard clocks. Now that the seats of some cars can be converted to form a double bed, an alarm for the car's clock would be an inexpensive and welcome addition.—*Bill Zukle, State College, N. M.*

Riding a World Champion

HARLEY-DAVIDSON

with the *HYDRA-GLIDE FORK*





"You ain't seen nothin' . . ." in motorcycling 'til you swing aboard this Harley-Davidson HYDRA-GLIDE streamliner! Man! What performance! You take off like a "jet job", skim over rough roads like a flying cloud, float like a breeze over bumps, steer with finger-tip ease, stop at a touch of the brakes! Even on longest trips you're fresh as a daisy, ever ready for more fun as you take in exciting race meets, endurance runs, hillclimbs, gypsy tours, and wonderful vacation trips. Whether you're an oldtimer or a newcomer, if you're looking for the greatest thrill in the world's greatest sport . . . *this is it!* One ride will convince you. See your dealer today. Mail the coupon now!

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Send free copy of ENTHUSIAST magazine, filled with motorcycle action pictures and stories; also literature on latest models.

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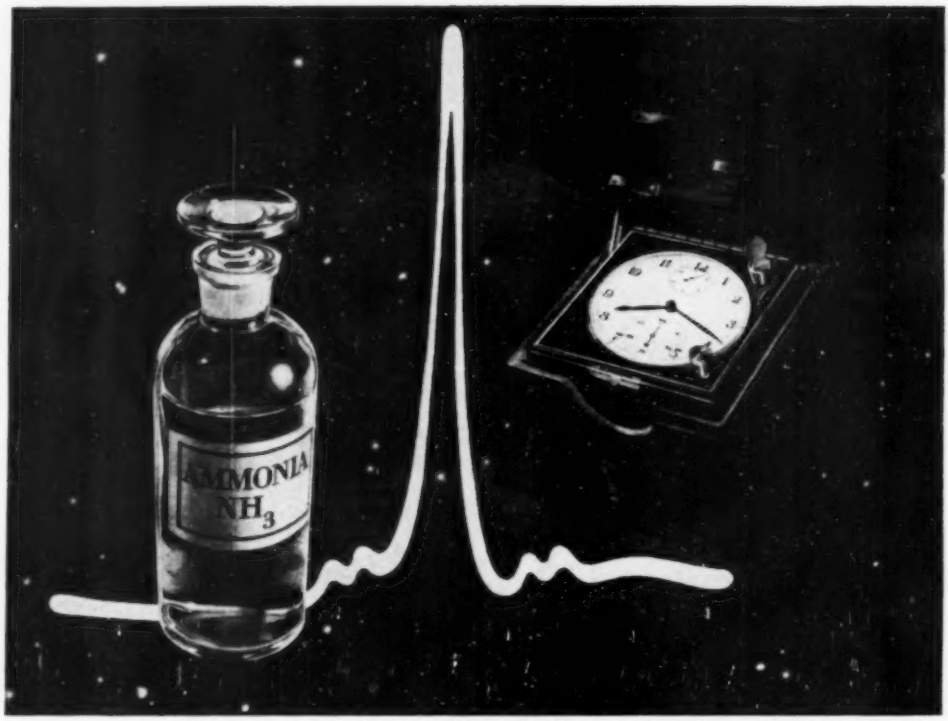

Using ammonia and radio waves, RCA scientists have devised a clock more accurate than the stars.

Your future will run on **"Atomic Time"**

Imagine a clock which will lose or gain only one second in 20,000,000, and which—when further research is carried out—will vary no more than *a second in 30 years!*

Such a timepiece—constructed by the National Bureau of Standards on a principle conceived and demonstrated at RCA Laboratories—is now in operation. More accurate than the stars? Yes, when Mother Earth wobbles in her orbit, "star time" will vary.

The pendulum of RCA's clock is an atom . . . at present, the nitrogen atom in an ammonia molecule . . . though others may later be used. Vibrating 23 billion 870 million times a second, it controls a system of radio waves and electrical impulses which operates the clock—locks them in tune with its own unvarying beat!

You won't need an "atomic clock" to get to the office promptly, or get your children to school. But scientists and engineers who must split seconds into millions of parts need this more accurate way of *telling time.*

The atomic clock is but *one* of the many major achievements pioneered at RCA Laboratories. Such leadership in science and engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

* * *

Examples of the newest developments in radio, television, and electronics can be seen in action at RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free. Radio Corporation of America, Radio City, N. Y. 20.

RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

PS
The Voice of Science

Wanted: Greaseballs with Degrees

THIS month, thousands of mechanical, electrical, and chemical engineers will grab the symbolic sheepskins for which they have worked so hard. But only some hundreds of the many thousands will find waiting for them the jobs they thought they wanted.

This is not a new situation for those who have become newly aware of the Help Wanted columns. It may be that the war years have exaggerated the annual problem of cutting sheepskins into jobs. The delayed educational program is now spurting a surplus of degrees.

But the war years have also produced a burst of delayed development in many industries. Automobiles, plastics, radio, and television (that kid brother of radar); chemical and flame farming, quite different from the old routine of the plow and harrow.

And, of course, there is a whole new going business—the biggest in the world—of fitting nuclear fission to people.

Maybe the old jobs for brand-new mechanical engineers in the automobile industry, for instance, are fewer. But there are some completely new jobs looking for takers.

These new jobs call for a white-collar education in the head—and a blue-shirt ability in the hands. Engineers with dirty fingernails; greaseballs with degrees. Take the new torque converters, for one thing. However handy he is with a wrench, the Gus that has to deal with them will find a mechanical engineering degree helpful in mastering their intricacies. The same thing holds true for dozens of other brand-new careers in the new-day machinery of living.

Even the servicing of this new equipment has become so complicated that willing hands must have knowing heads. The big gap right now is between the white-collar engineers who have designed these mechanical miracles and the people who press the buttons—and don't know what happens until it doesn't.

This is where the dirty-hands engineer comes in. It's a brand-new *kind* of job. The young men who take these young jobs will be lucky guys. They will have a chance to do their stuff with their heads as well as their hands.

In this they will have it all over the old grads who had to find a clean-hands job—and a dirty-hands hobby. They will be able to combine the know-how of their heads with the know-how of their hands. They will be operating the new machinery of living, whether torque converters or atomic piles.

Actually, there is small distinction between those who are competent with their hands and their heads. As, Professor L. L. Thurstone, of the University of Chicago, put it, it is a common misbelief that the boy who will be good at mechanical work needs only to be handy with his fingers—and be willing to get his hands dirty. The real aptitude, he concludes, is mental.

Perry Githens

IF YOUR HOME REPAIRS LOOK LIKE THIS...IT'S TIME TO BUY SOME TOOLS...

and

IF YOUR CAR FEELS LIKE THIS IT'S TIME FOR MARFAK CHASSIS LUBRICATION

THAT CUSHIONY FEELING LASTS LONGER WITH **MARFAK!**

It's a hard, tough job to protect your car's vital wear points. So for longer-lasting, sure protection, get *Marfak* Chassis Lubrication. It is specially compounded to fight wear and friction — not for just a couple of hundred miles but for 1,000 miles and *more!* You can tell this is so by that grand "cushiony" driving ease that *stays* with you. Ask for *Marfak* today at your neighborhood Texaco Dealer, *the best friend your car ever had.*

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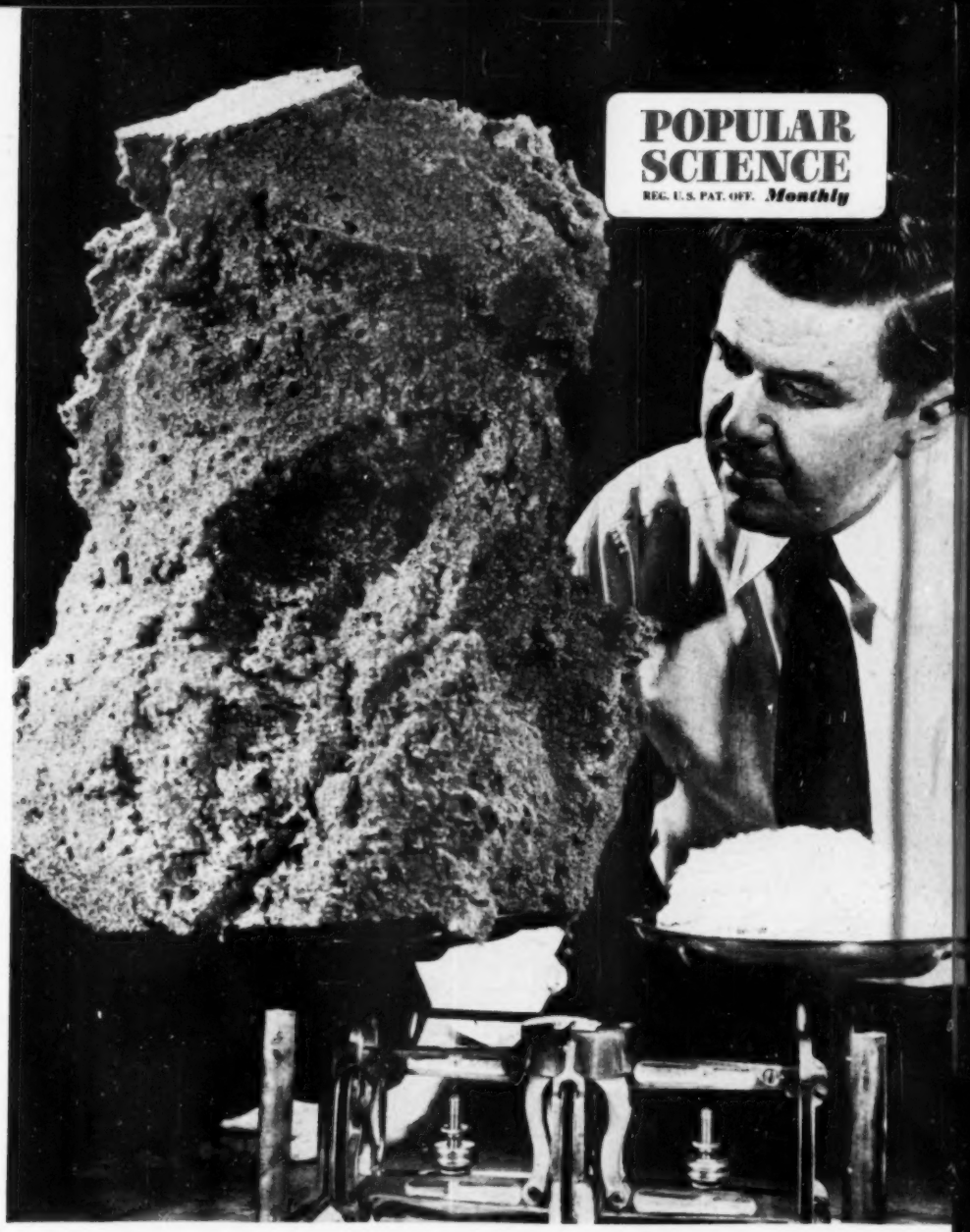
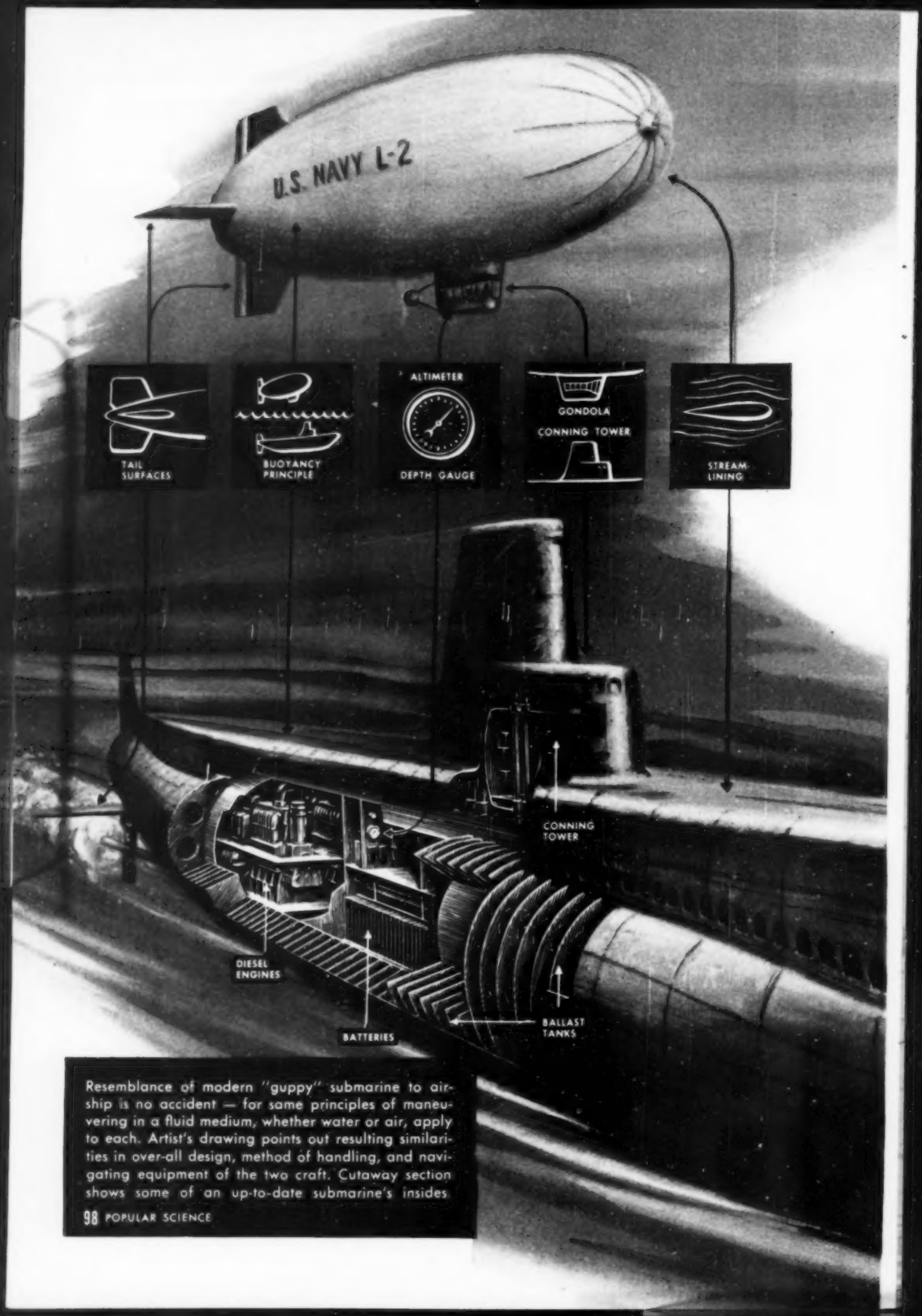
TUNE IN . . . TEXACO STAR THEATER every Wednesday night starring Milton Berle. See newspaper for time and station.



Weighing in a Lightweight . . . The mountainous mass weighing in above is a new champion—the world's lightest solid. And if you don't believe it, look what's balancing it—just five ounces of fluffy pie meringue. Developed by Westinghouse, the spongelike substance is a new plastic-foam insulating material, made by oven-baking a liquid phenolic resin at 350° F. for 15 minutes. Filling with air bubbles, it swells to 100 times its original volume. Since the liquid has such a small fraction of the bulk of the foam, it can be shipped and stored with valuable saving in space, then expanded as needed.



Resemblance of modern "guppy" submarine to airship is no accident — for same principles of maneuvering in a fluid medium, whether water or air, apply to each. Artist's drawing points out resulting similarities in over-all design, method of handling, and navigating equipment of the two craft. Cutaway section shows some of an up-to-date submarine's insides.

Cover by Reynold Brown

High speeds submerged and a long-distance nose make them the deadliest warships known—but it takes better men to run them.

New Subs Are Undersea Aircraft

By Perry Githens

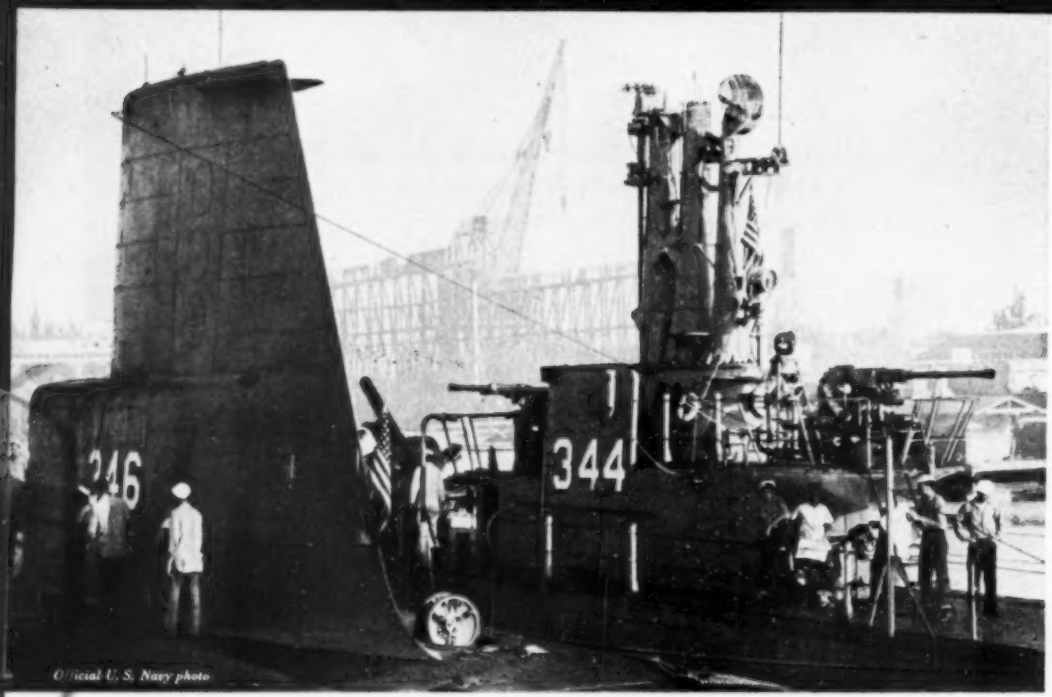
PS photos on location by W. W. Morris
Drawings by Ray Pioch

LOOKING at the U.S.S. *Tusk*, you wouldn't guess this waterborne bomber to be one of the most important warships in the world. She's as sleek as a wet seal: only the conning tower breaks the smooth line of her deck. There isn't a weapon in sight. In fact, the biggest guns aboard, when I visited the *Tusk* at the U. S. Submarine Base at New London, Conn., were some .45 pistols and a 12-gauge shotgun.

It isn't guns that make the *Tusk* deadly. It is the new thinking and equipment housed in that innocent-looking hull. The conning tower is crammed with electronic consoles and stacks that can tune in a target or sense a danger miles away. Machinery to drive the ship deep, far, and fast. Machines that make torpedoes, those original guided missiles, think for themselves. Machines by the ton—and 70-odd men whose selection and training make them the best machine of all.

The *Tusk* is one of several fleet-type subs converted into guppy-snorks. So much bilge has been splashed over the words "Guppy" and "Schnorchel" lately that I had better define them.

"Guppy" is simply a code word like OVERLORD or CROSSROADS. The GUPPY project was the development of



Official U. S. Navy photo

Striking contrast between sleek superstructure of guppy sub streamlined for underwater speed, left, and cluttered topside of a conventional fleet-type boat is seen in this side-by-side view.

fast underwater speeds by (1) beefing up the batteries and (2) streamlining the hull.

"Schnorchel" was the Germans' phonetic name for the breathing tube that enabled late-model Nazi subs to run their Diesels while submerged. It has also appeared in print as "schnorkel." The British shortened it to "snort," but the Navy has compromised on "snorkel."

Early experimental conversions were simply fleet-type subs equipped with snorkel, or guppies with high-speed batteries but no snorkel. The guppy and the snorkel were then combined in subs like the *Tusk* and the *Cochino*. It is these guppy-snorks that are the prototypes of a completely new kind of warcraft, forcing a completely new approach to naval operations.

What we have called a "submarine" was actually a "submersible torpedo boat." We have had submersibles, in the modern sense, since Simon Lake built a boat that could go all the way under—and come up. Now we are getting nearer to true submarines. Not just buttoned-up surface ships that can dunk for a few hours, but subs that can operate for weeks without lifting more than a nostril above the surface. Undersea boats like steel whales—killer whales with men in them—that can swim as fast submerged as most of their targets can go on the surface.

These new submarines look more and more like aircraft. Shiplike guns and rails are gone. Periscopes, snorkel, and antennas retract into a conning tower faired in as slick as a jet engine. Topside rudders, still

How a Sub Maneuvers

1. To cruise on surface, emptied main ballast tanks, left, make sub lighter than water. "Positive" buoyancy may be 600 tons.

2. For diving, flooding these tanks makes sub heavier than water. Bow and stern planes, tilted as shown, aid in maneuver.

experimental, make some new jobs look like iron blimps. And that's just what they are.

The parallel came clear to me this spring. One week I was under water off New London in a submarine. The next week, I was flying low over the Caribbean in a blimp. Our airship, on anti-sub patrol, caught a sub smack on the surface. For fifteen minutes, the two ships maneuvered at high speed, each in its element. The sub twisted to escape, writing its name in the wake as sailors say. The blimp jockeyed to get into attack position, making turn for turn.

Talking with the pilot, after the simulated bombing, I learned that an airship is not really "lighter than air." It is run a little heavier than air, using its power and tail planes to fly up and down. Only when handling a blimp at low speeds is it necessary to lighten ship by dropping ballast. To make a blimp heavier, you blow air (heavier than helium) into a fabric tank in the balloon.

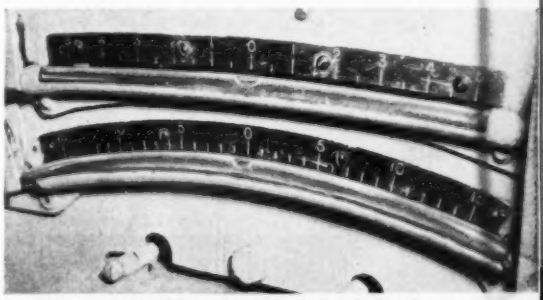
"Blimps" That Swim

Submarines work the same way. The similarity is obvious when you remember that air behaves like a fluid. Subs have ballast tanks that water is admitted into or pumped out of to maintain the desired depth at low speed. But the angle of dive is set by the bow and stern planes. And the guppies can swoop and swerve like a blimp, using only the stern planes at the new underwater speeds. Speeds that would shame a real whale, at angles of dive and climb that would have seemed fictional a year or so ago.

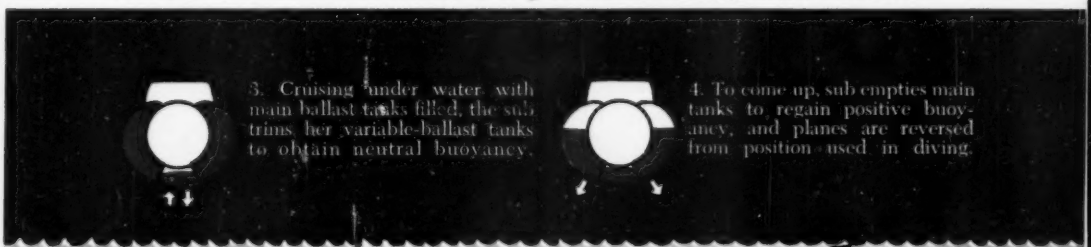
Just to complete the picture, the new subs actually have altimeters on the bulkheads. Submariners (they are more likely to pronounce it submarEEners) keep an eye on these atmospheric-pressure indicators while snorkeling.

The snorkel, as you know, is a nose. A two-way nose. One nostril, lifted higher, ▶

In control room of U.S.S. *Cochino*, new-style guppy sub, the chief of the watch operates levers that flood ballast tanks for diving by venting their air. Panels above, with red and green indicator lights, are "Christmas tree" that tells him when ship is ready to submerge.

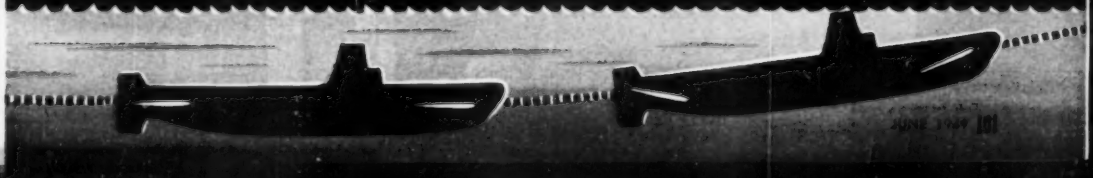


Instrument resembling carpenter's level, familiarly called "the bubble," shows fore-and-aft inclination of sub in diving and rising. Scales show small and large angles in degrees.

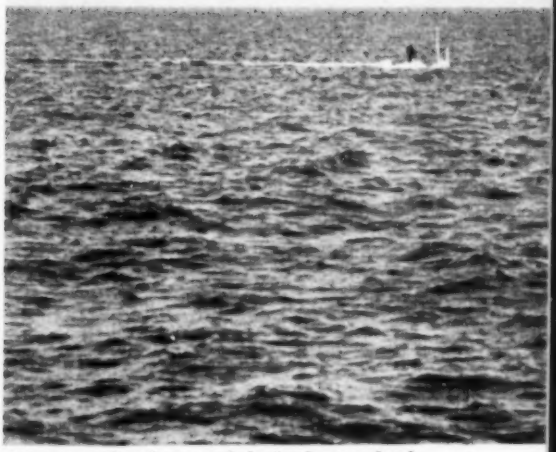


3. Cruising under water with main ballast tanks filled, the sub trims her variable-ballast tanks to obtain neutral buoyancy.

4. To come up, sub empties main tanks to regain positive buoyancy, and planes are reversed from position used in diving.



Snorkel of U.S.-designed sub, above, consists of air-intake tube rising just above surface when craft is running submerged and exhaust tube venting engine gases just below surface.



Even on calm day, snorkel of submerged sub, seen here from 300 yards, leaves wake about as conspicuous as that of an outboard motor. Whitecaps would make it much harder to see.

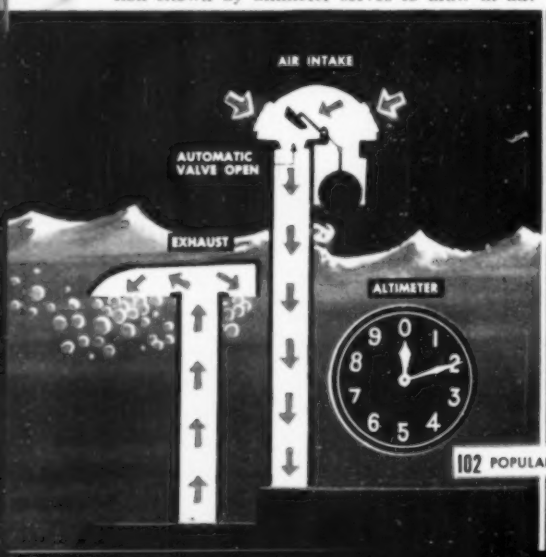
takes in air for the hungry Diesels. The other, which can even be a little under the surface, exhales the exhaust gases.

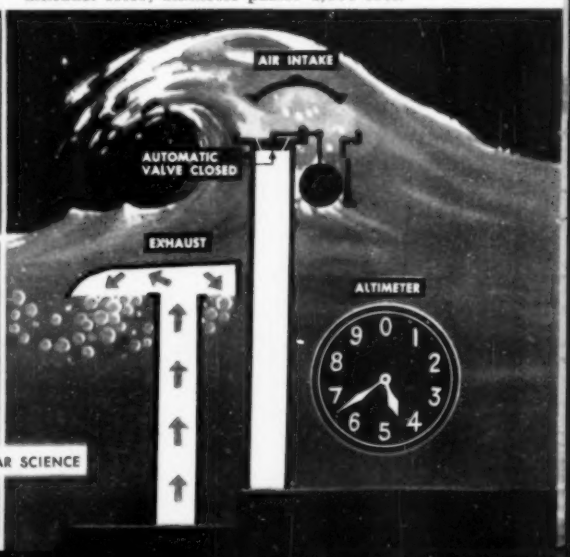
When a wave smacks the intake, it closes like the nose of a trained swimmer. Instantly, the engines start sucking the air contained in the sealed boat. The atmospheric pressure drops; the altimeter hands climb to a simulated altitude of several thousand feet.

Scant seconds later, the snorkel clears. You swallow hard: to your ringing ears the sensation approximates an aircraft dive at fighter-plane speeds. Snorkeling affects the whole ship and everyone in it. The refrigerator in the galley, for example, must have a vent in the door or the sudden change of pressures might cause the door to slam the cook silly. Snorkeling can be bad enough when you are awake. It's a

Principle of U.S.-type snorkel is shown in diagrams. With intake above water (below), air pressure in sub is almost normal. Slight suction shown by altimeter serves to draw in air.

When wave hits intake, automatic valve closes, preventing inrush of water. Continuing exhaust may lower air pressure in sub to that of high altitude. Here, altimeter passes 4,600 feet.





real problem with men off watch and asleep: the business of equalizing pressure in the ears is not involuntary like breathing.

The new subs, although converted from the basic fleet-type I knew in 1943, seem even more crowded with men and gear. Bigger battery rooms are one reason. The new cells are thinner, but there are a lot more of them. The enlisted men now have to "hot bunk" because expanded battery needs have cut off a couple of tiers of sacks. The junior officers sleep three-deep in staterooms smaller than a Pullman section.

The *Tusk*, in 1949, carries no bigger crew than the *Bowfin* in 1943. But there is a great deal more equipment today, and a great deal less living room. On this, it seems to me, rests the heaviest weight of future submarine operations. The Navy knows that the effective limit of the new, true submarines will be defined, not by the machinery, but by the men who run it.

New Batteries Change Tactics

In the not-so-old days of the fleet-type subs, charging batteries meant wallowing on the surface, Diesels throbbing, for hours. They submerged only to thread waters made dangerous by surface or air craft, to make an approach on a target, or to go 'way downstairs to wait out an anti-sub attack. They couldn't go very fast under water, so they kept very quiet. Usually, they shut off all possible noise-making machinery—including the air-conditioning. They sweated it out as the paint burst off the bulkheads.

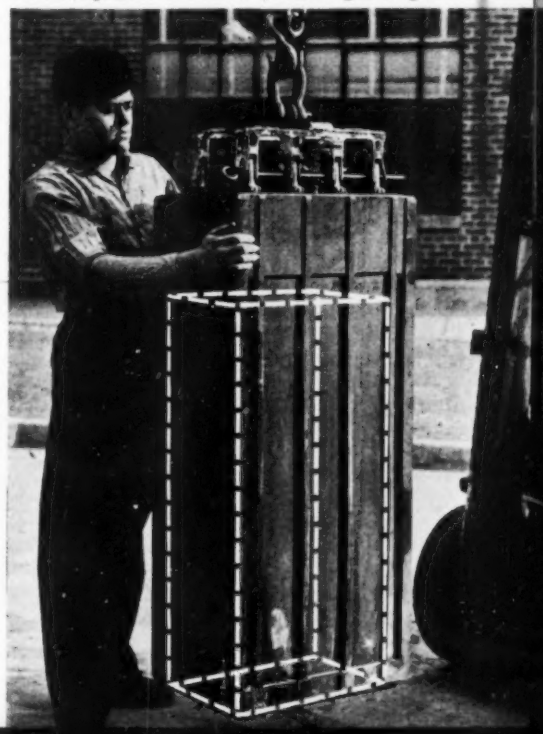
Pre-snorkel subs went under only when they had to; new subs need come up only when they want to. They need not surface to speed up or charge batteries, exposed to enemy radar, radio direction finders, and aircraft. On snorkel, they can make knots or charge with Diesels. Running deeper on batteries, they can dash on a target, snap their fish, and get the hell out, as submariners say, but fast. Or they can come back like a barracuda for another bite.

To operate like this, flying and living blind for maybe weeks at a time, will call for even more emphasis on the selection, care, and feeding of submariners. The ability to work and live together will be more than ever the measure of the men who wear the dolphins.

To translate into everyday terms, suppose the steering wheel of your car were in the middle of the front seat. Put a man on the left with one hand on the wheel, a man on ➧

Diving officer keeps tally with this panel as rigging of each part of ship for diving is checked by men and double-checked by officers to make certain every opening is sealed.

Deep-cruising sub runs on electric batteries of many cells like one below. Photo shows standard type. The more compact guppy type (dotted outline) permits more cells, boosting voltage.



View looking forward in conning tower of guppy sub *Cochino* shows helmsman at steering wheel, quartermaster keeping log, and telephone talker. Upper view, next page, is looking aft.

the right with his hand on the wheel. Let man in the middle handle the brake and clutch pedals. Another man in the back seat has the shift lever and accelerator. The windshield and windows are blacked over. Only you can see out. Now start driving. That's about what it takes just to stay alive in a submarine under peacetime conditions.

It is harder to imagine the human pressures of submarine living. Take a clean railway tank car. Air-condition it, hang up the stock of a fair-sized hardware store. Now get in—you and 75 other guys. You are going to work, eat, sleep, shave with your elbows tight. For a lot of days you will not be able to move a foot without bumping something or someone.

The Navy's problem is to make such conditions bearable over long stretches of time in a short reach of space. For a man's job may be scant feet from his sack. So the Navy is experimenting with everything, from lighting and color schemes to fabrics, to create an envelope of comfort in a small, steel world.

Old hands would pop their tattooing at some of the new decor for subs. Engine rooms stay a stark, cool white, but other compartments in some new boats are done up in warm grays and greens. Drapes (there are no doors) in the officers' narrow country are a quiet wine red. The fabrics of mattress covers and blankets are tested for their ability to breathe, to feel right, and to resist odor.

Smells are important in such close quarters. Even with air conditioning, the atmosphere must be constantly refreshed. Air from the toilet rooms, for example, is ingeniously piped to the Diesels.

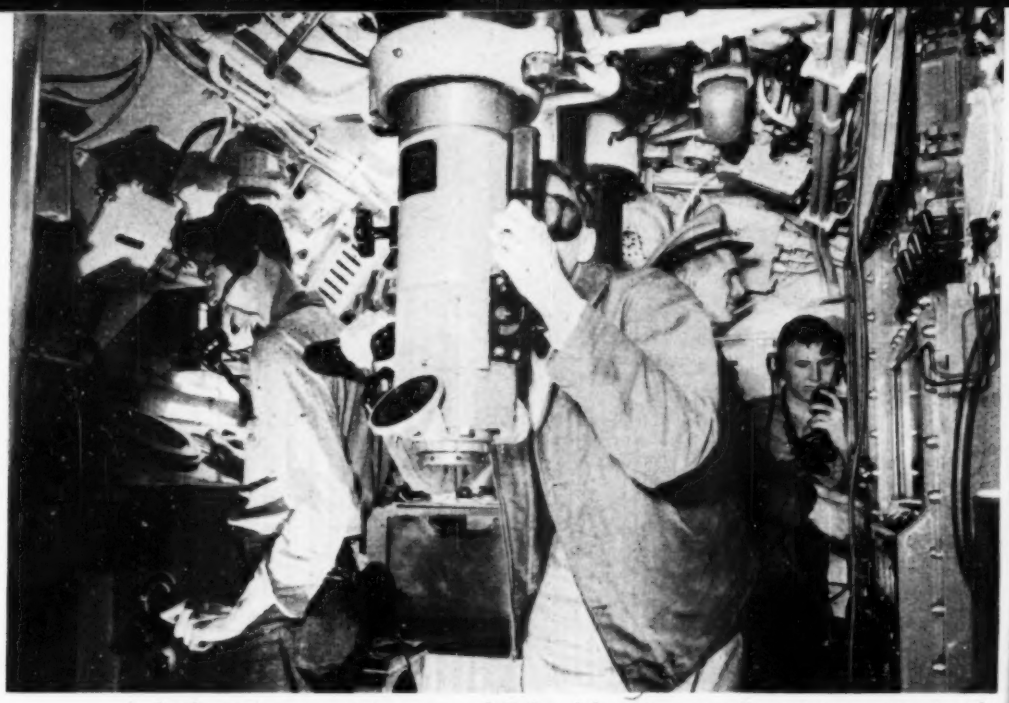
Even Lamps Are a Problem

An important small problem is the design of reading lamps in the bunks that will give adequate light yet not disturb sleepers a few feet away.

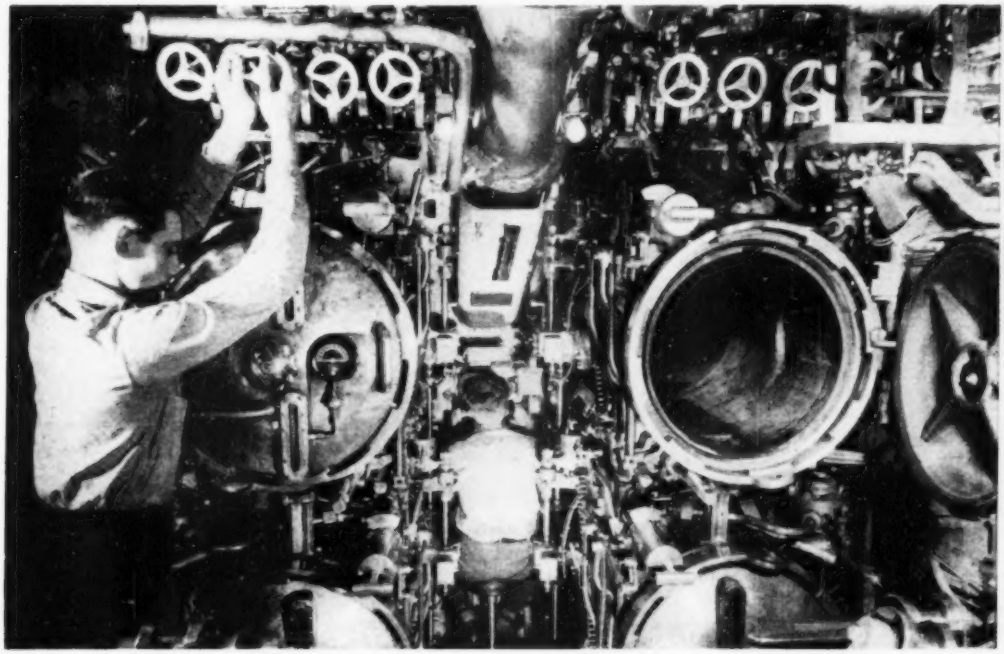
All of this deep-sea flying, of course, is "on instruments." Men must stand watch, staring for hours at gauges, spinning dials, flickering sonar and radar scopes. Electronic eyes and ears are wide open all the time. Men must be attentive to catch the change of a bubble in a spirit level, the shift of a needle, or the pip of light on a scope that might spell trouble.

How much staring can men stand? How much light is needed for seeing? What are the limits of seeing, anyway? These are some of the questions the Navy is trying to answer with its own basic research.

The guppy-snork conversions operating right now have already demonstrated the tremendously increased importance of the submarine. As this is written, the forgings for the pressure hulls of completely new subs are being locked together. Designed afresh from keel to snorkel, these undersea bombers may well be the deadliest craft in the world. But they will be only so much wet steel without the men who make them effective. END

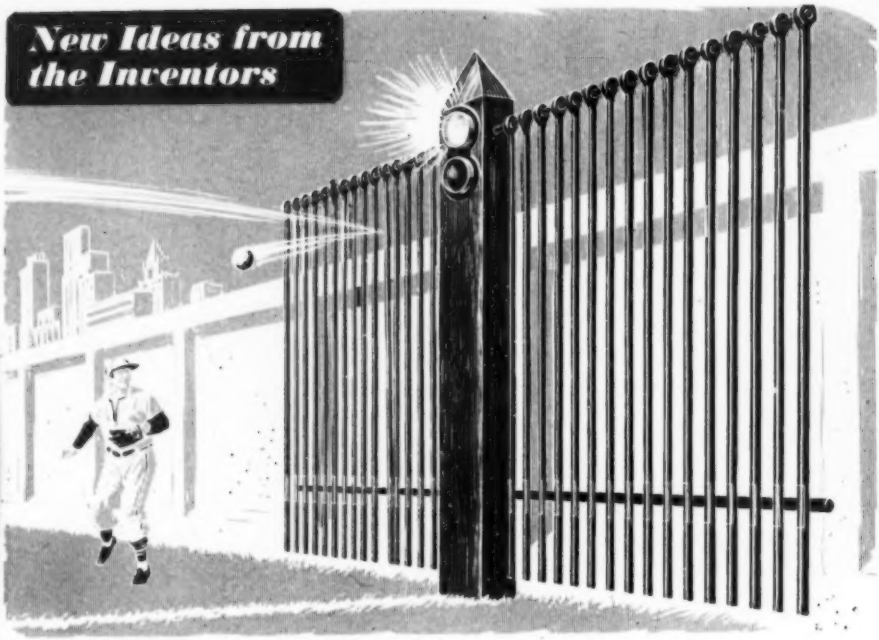


At battle stations in conning tower of U. S. guppy-type sub *Cochino*, skipper at periscope takes bearing on target while radar operator, left, gets range. Computer operator at right finds target's course and speed. Fire-control talker is in communication with torpedo room.



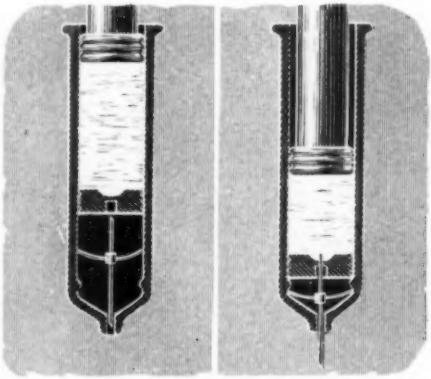
Four of *Cochino's* ten torpedo tubes are seen here. Torpedoman at left blows water from a tube, after firing, in preparation for reloading. Tube at right is shown opened as to receive torpedo. Scene is in the *Cochino's* forward torpedo room, looking toward the bow of the vessel.

New Ideas from the Inventors

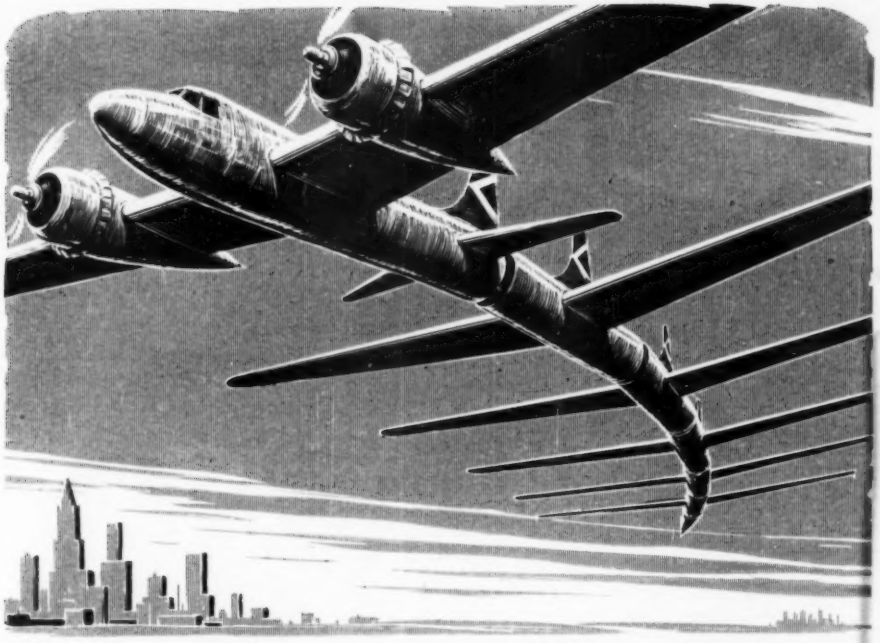


Automatic Ump Calls Fouls. There'd be no arguing with the umpire with this foul-ball indicator, invented by A. K. Nelson, of Washington, D. C. To be placed at the end of each foul line, it consists of closely spaced rods hanging to the ground on both sides of the line. When a ball strikes the rods, their movement actuates a switch that lights up a green light if the ball is inside the line, a red one if it is outside.

Milk Orders at a Glance. Just flip up the tabs on this handy order device, and you wouldn't have to write notes to the milkman every day. The tabs have typical dairy orders printed on both sides so you can read them when they're down and the milkman can read them when they're up. J. L. Churchill of Seattle, is the inventor.

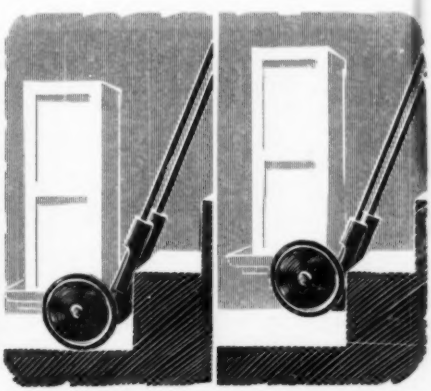


Hypo Is Ready. This pre-filled, emergency hypodermic would need no assembly or sterilization. Pushing in the plunger forces the needle out through a seal that keeps it sterile. Further pushing then forces the medicine down on the inner end of the needle, through another seal. The inventors are R. P. and J. O. Scherer, of Detroit.

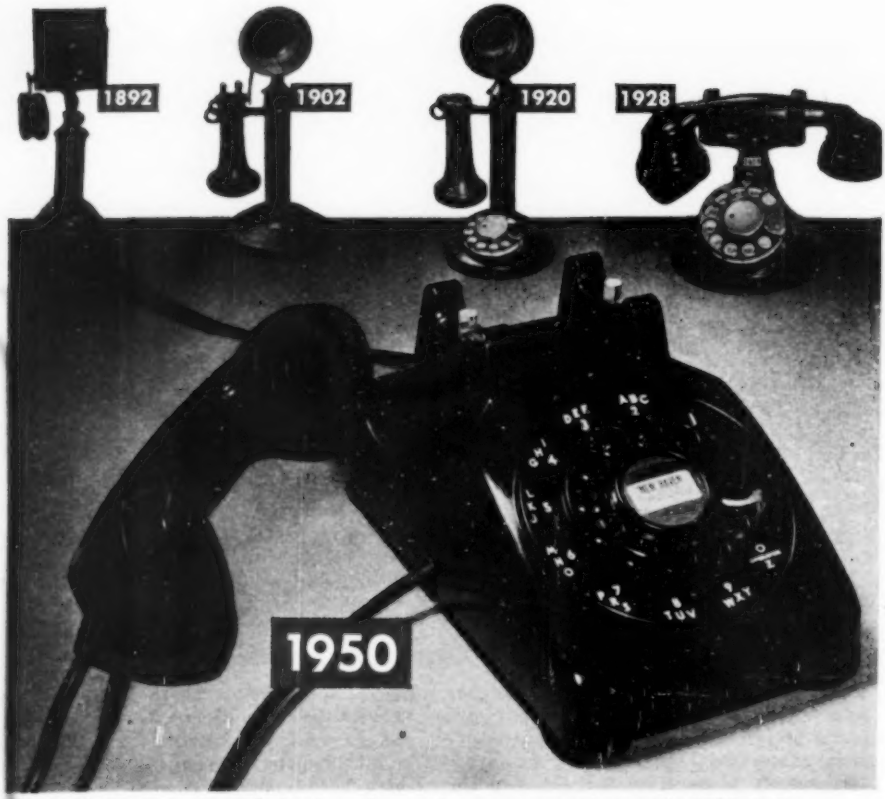


Plane Tows Trailers. This streamlined "flying trailer" would carry bigger loads, fly faster, and be more maneuverable than conventional glider trains, claims its inventor, B. Mitchell, of San Diego, Calif. Since the gliders are all shaped like extensions of the towing plane, they would offer less air resistance, he says. A special hitch permits them to move only up and down and sideways, keeping them from twisting.

Flashlight Shines Warning. An ordinary flashlight lights this handy warning signal for motorists with disabled cars. The sign fits over the flashlight's lens, and the light is reflected out through the cut-out letters. A round base holds the flashlight upright and carries four extra batteries. C. J. Delmotte, of Detroit, is the inventor.

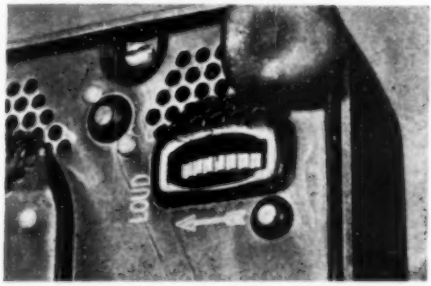


Truck Slides Upstairs. Sliding shoes on the handle of this hand truck, invented by J. C. Gates, of Indianapolis, Ind., help it climb stairs. Placed against the edge of a step, they steady the truck while its handle bars are pulled up through them. At the top of each step, springs snap them up again, ready for the next step.



Phone of tomorrow is a culmination of many improvements since early 1892 desk-type set.

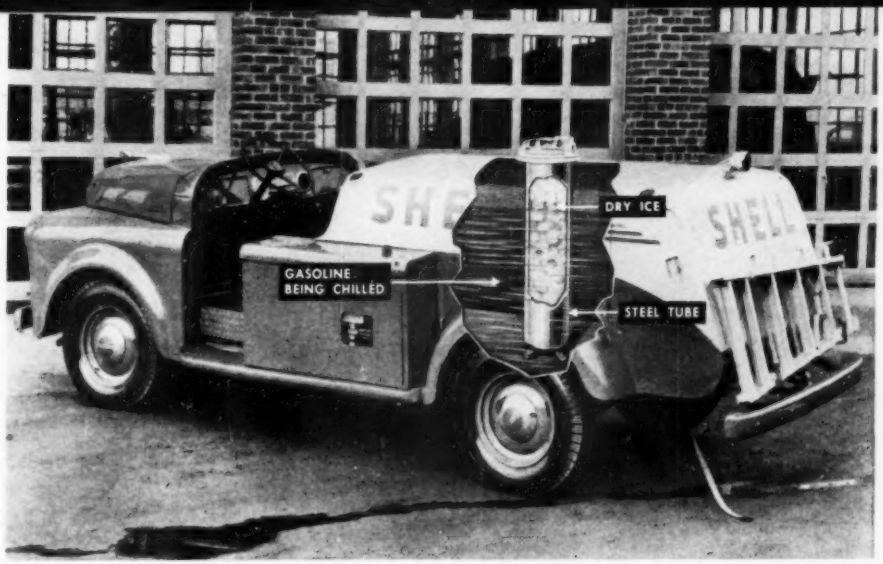
New Phone Rings Loud or Soft



A rotating knob, recessed into bottom of instrument's base, enables you to adjust ringing volume of the new phone at will. Turning it in direction of the arrow makes the ring louder.

THERE'S a new telephone on the way that will let you control the loudness of its ring. And at whatever volume you adjust it to, the ringing tone will be both lower-pitched and more resonant than that of your present phone. For easier dialing, the numbers and letter prefixes are placed outside the finger wheel. Another feature is an "equalizer" that automatically adjusts the voice sound level to compensate for the difference in distance between each telephone and the central office.

The phone's handset—transmitter, receiver, and handgrip—is slightly smaller than earlier models, weighs 25 percent less, and is designed for a more comfortable head fit. The new instrument, developed by Bell, is still undergoing tests. Some trial installations will be made this year, but regular production, by Western Electric, will not get under way until late 1950.

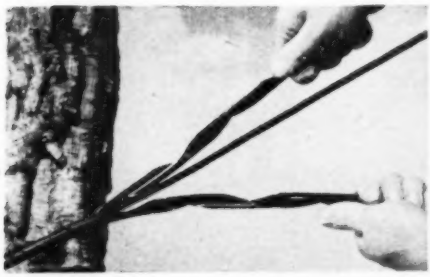


Dry Ice "Squeezes" Gasoline

Did you know that you get more miles out of a gallon of gasoline on a below-zero winter day than on a sweltering August one? You do—and the reason is that cold shrinks the gas, making it heavier. Thus you get more pounds per gallon. And as your engine burns *not* gallons but pounds, the benefit of cold gasoline is obvious.

Bill Odom's 5,000-mile, nonstop flight from Honolulu to Teterboro, N. J., last March (PS, May '49, p. 128) proves the point. Before take-off, his 288 gallons were chilled, as shown above. Although the actual volume was still 288 gallons, the weight was the equivalent of 300 gallons, giving him an extra 1,122,000 B.T.U. Without it he might have had to set down short of his goal.

Odom's gasoline was chilled with dry ice—a method, shown above, developed by the Shell Oil Co. A pound of dry ice a minute was poured into the tube immersed in the gasoline, and the fuel was cooled from 80°F. to 20°F. in six hours. The tube itself held gasoline to promote heat conduction.



Plastic Protects Power Lines

A single lineman, twisting two spirally interlocking Tenite® plastic strips, as shown above, quickly builds up a protective tubular sleeve over a power line. No special tools are required for the installation. The new covering, which is flexible and lightweight, protects lines against abrasions by trees and other obstructions. Tenite not only is weather-resistant, but has high impact resistance and serves as an insulator.

Shootin' Iron Fires Smoke

This 11-inch-long revolver "smokes" like a real Frontier-model .45. Every time the trigger is pulled, a puff of harmless magnesium-carbonate powder is automatically forced out the muzzle by a bellows arrangement. One loading is said to be enough for 5,000 shots. Cast from a heavy, durable zinc alloy, with a pearl-colored grip, the ".45 Smoker"® sells for $1.95. It is made by Products Engineering Co., Portland, Oregon.

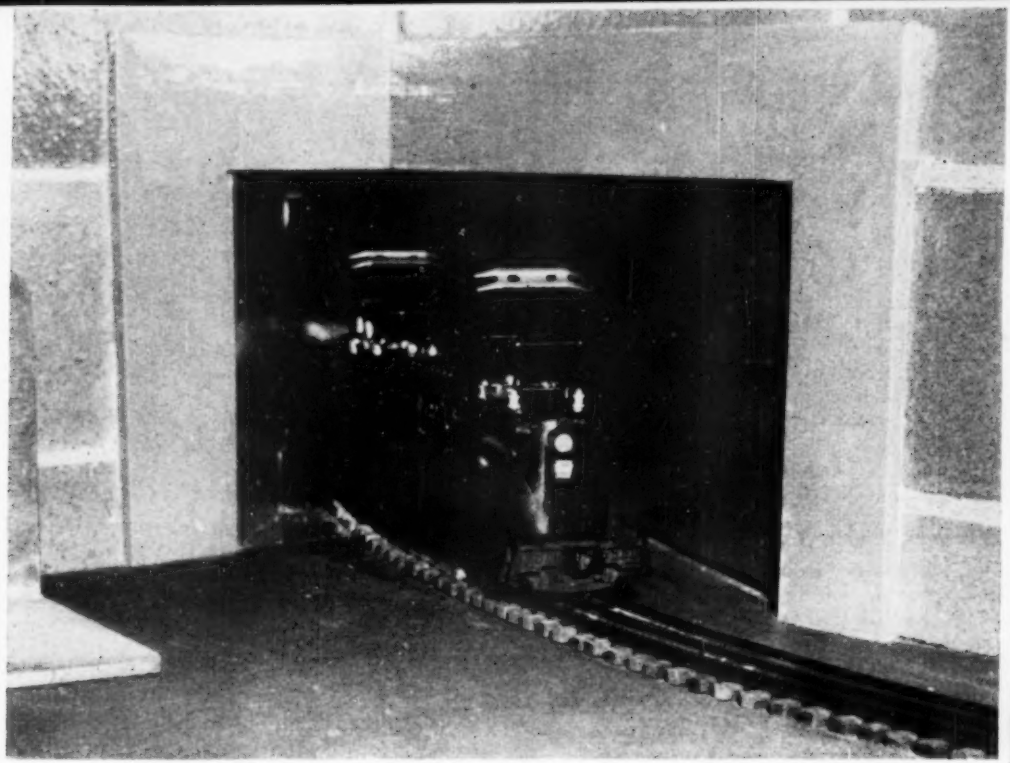
The "Hot Cargo Express" in the Cleveland Clinic picks up its radioactive load—the tiny capsule of radon gas held in the long tweezers (above)—for trip from storage to laboratory.

O-Gauge Pike

KIDS long ago became resigned to seeing Daddy play with their toy trains most of the time. Now some grown men have taken over a model railroad full time—and they are not just playing. The miniature electric train carries highly radioactive radon gas, used in cancer treatment and research, back and forth between a storage room and a laboratory, eliminating dangerous handling.

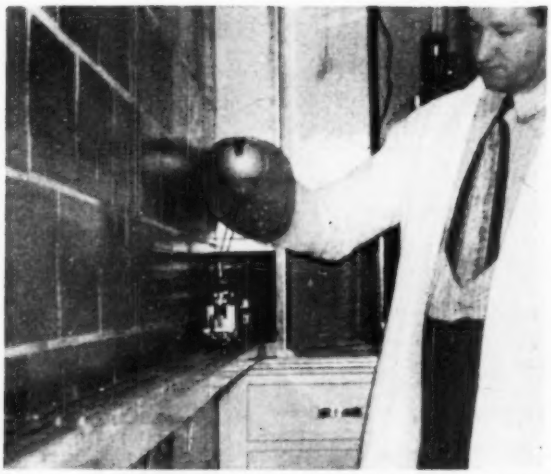
The model—a standard Lionel O-gauge locomotive copied from the Pennsylvania Railroad's GG-1—shuttles over a 21-ft. right of way, hauling its "hot" cargo in a lead-lined flatcar. It is the first part of a completely automatic system for transporting radon in the Cleveland Clinic. Eventually, reports Dr. Otto Glasser, medical physicist, the train will be equipped with an automatic dumping device to drop the radon capsule into a pneumatic tube. This will shoot the capsule directly to the hospital's surgery room. When this system is completed, technicians will hardly need come near the radon.

In the measurement laboratory, a technician checks the radioactivity of the radon-gas capsule with this instrument. The capsule itself is still in its lead-lined flatcar about six feet away.

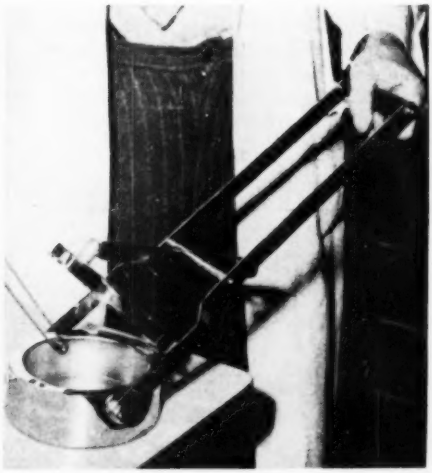


There's even a tunnel on the 21-ft. right of way where the model train passes through the wall separating the rooms. The radon, used in cancer treatment, is too "hot" to be held in hand.

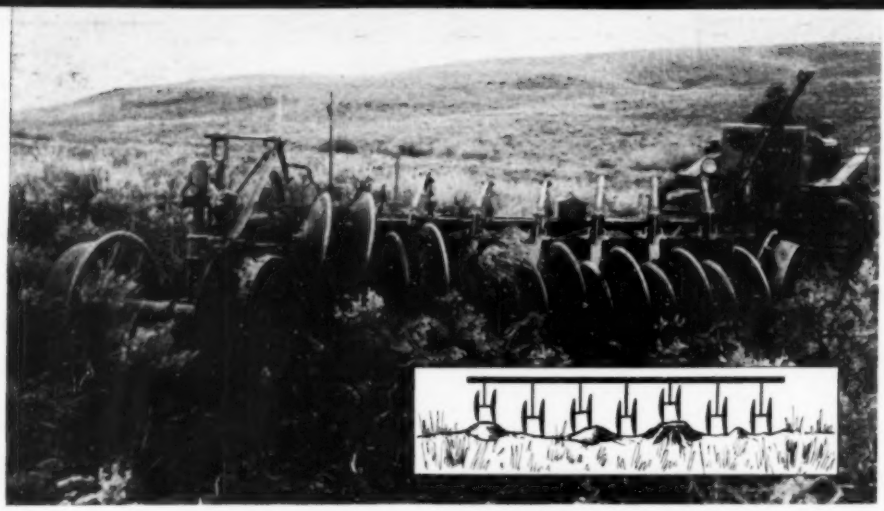
Highballs Hot Cargo



The train takes the capsule back to the storage room after measurement, and technician picks it up with tweezers. Remotely controlled dumper is being installed to unload car automatically.



Trip to surgery is now made in hand-carried lead box, but eventually pneumatic-tube system will be used. This will still further reduce the time scientists are exposed to the deadly rays.

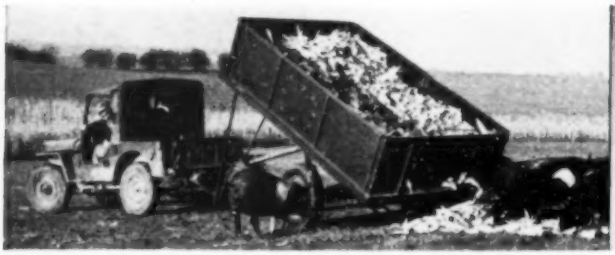


Brush Plow Has Knee Action

THIS new Brushland disk plow rolls right over stumps and rocks without breaking. Each pair of disks is individually mounted on powerful springs, permitting the plow to move up and down over obstructions without fouling (inset). The uneven size of the paired disks causes them to scrape the ground at an angle, giving them a deep cutting action. During one recent test, the plow rooted out 97 percent of the brush. Although much heavier than other disk plows, it requires no more pulling power, due to its ball-bearing action. The new plow was developed by the U. S. Forest Service.

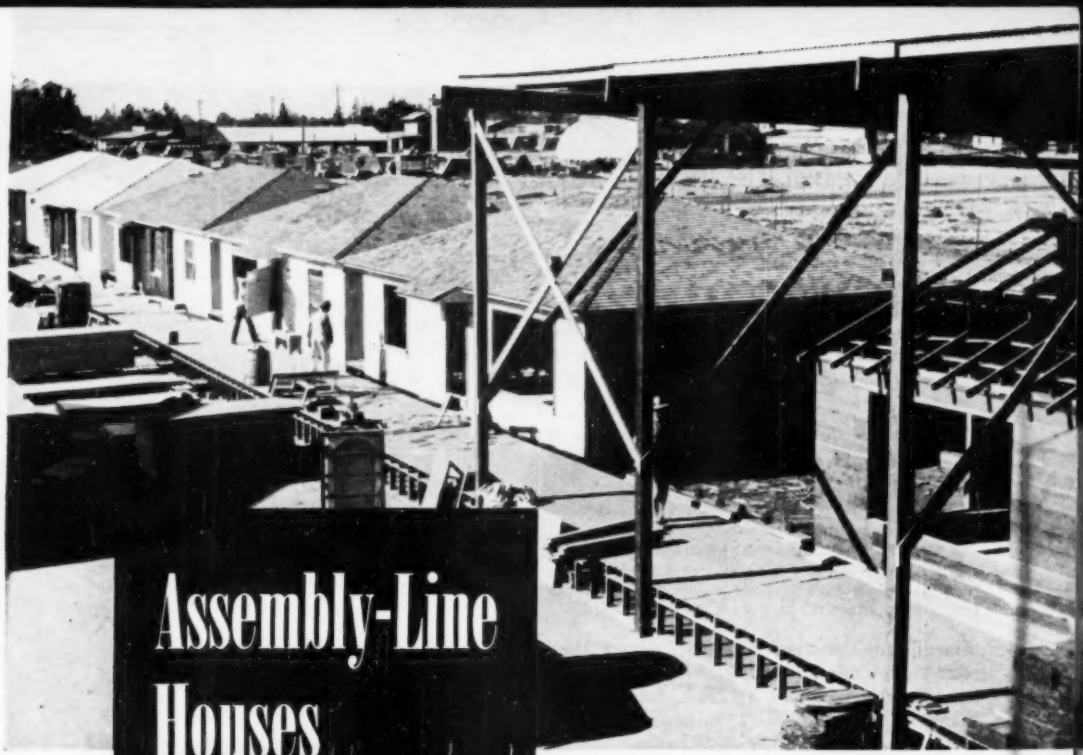
Train Introduces Twin Beds

CLAIMED to be the first accommodation of its kind on a sleeping car, the twin beds at right are a feature of the Pennsylvania Railroad's new Broadway Limited. The arrangement is achieved simply by folding back a partition between two adjoining parallel bedrooms. The beds, made up before a run, fold into the wall and can be opened out by passengers at the touch of a lever. Each room has two chairs for daytime use that at night are folded and stored under the lower berths. Upper berths, not shown in the photograph, are concealed in the ceiling.



Trailer Is Self-Dumping

THIS Tri-Tralor® tilts up and dumps its load when you back it up. The backing action telescopes a tongue and pushes up rods that raise the front end of the hinged body (right). Made by Hotchkiss Steel Products, the trailer will carry up to 5,200 pounds.



Assembly-Line Houses Hit the Road

In newest answer to prefab's distribution problem, entire finished house, lacking only foundation, is trucked to site on tricycle trailer.

By Robert Richards

A house a day rolls off this assembly line in Bakersfield, Calif., where automobile-factory methods turn them out for as little as $4,700. Homes are moved in single unit to site.

MOTORISTS on California highways have had to contend with a new traffic obstacle lately—houses. Full-sized houses on queer, three-wheeled trailers, rolling down the road at 30 m.p.h. On the rear of each one, a sign: "Pardon the delay; another Mobilhome is on the way."

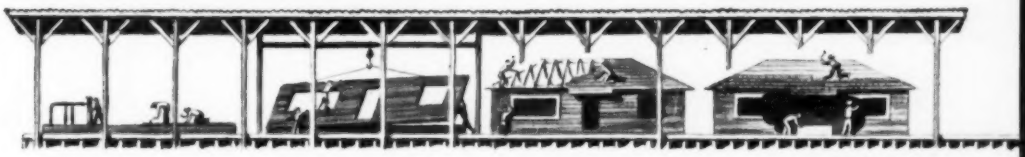
The obstacle is the latest development in the search for less-expensive houses. Mobilhome® is another name for Hugh Curran. An ingenious building-supply dealer of Bakersfield, Calif., Curran thinks he's licked ➧

1. In first step on assembly line, pre-cut floor **joists are laid,** plumbing core set in, and flooring put down.

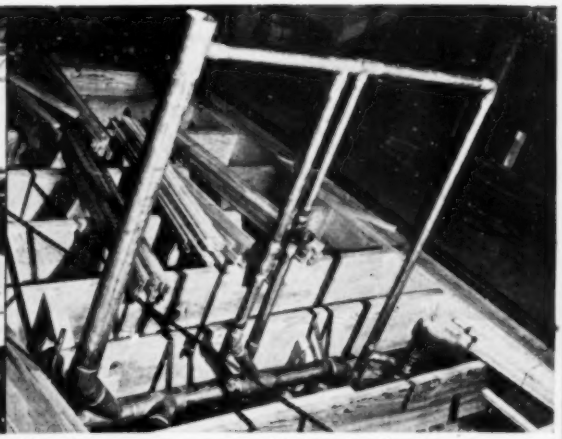
2. Wall sections with exterior siding, pre-assembled on jigs, are next hoisted into place. Partitions also go up.

3. In third position, rafters are erected and roof sheathing is nailed on. At same time, window jambs go in.

4. Here roof gets shingles, and eaves are boxed in. Electrical wiring, furnace, and bathtub are installed.



Extra-heavy construction shows before floor is finished. Notice diagonal steel bracing from left corner and the big joists. Section moves to next job on rollers (under rail, in left foreground).



Plumbing core is pre-assembled in shop beside production line. One above is lightweight copper—one man can handle it—although most of the Mobilhomes® use standard cast-iron cores.

the distribution and erection bogies that have gobbled up one prefabricated-house maker after another. To do it, he's tried to gain the transportation savings of site fabrication (PS, Nov. '47, p. 146) while retaining the "house different from your neighbor's" appeal of the prefabricator.

Shipping houses whole isn't entirely new. Goodyear's Wingfoot Homes ® (PS, Aug. '47, p. 73) were completely factory-assembled. But the Mobilhomes are as roomy as the average conventional small house—and even more heavily built.

This revolution in home building started almost by accident. An oil prospector came to Curran with a special housing problem. "I want to build a house out where we're working," he told Curran. "But can we build it compactly, so it could be moved if the oil drilling doesn't develop as we expect?"

If it had to be a mobile house, Curran got to wondering, why haul men and materials all the way out to the oil field to build it? "Why not build it right here, where things are handy?" he asked. "Then we'll tow it out to your site."

Building it "where things are handy" saved so much time, and moving it afterward proved so easy and cheap, that Curran promptly set up a real assembly line. Now it's turning out a house a day. Tested by two years' operation, his Mobilhome Corporation is now stepping into the national field, but keeping its neighborhood-factory system. With its processes protected by patents, it already has licensed locally financed firms in Sacramento, San Jose, and Menlo Park, Calif., and Milwaukee. Builders in Chicago and Detroit are negotiating for franchises. The parent company charges one percent of sales for each license. Design and price may vary slightly from plant to plant, as climate and building codes vary.

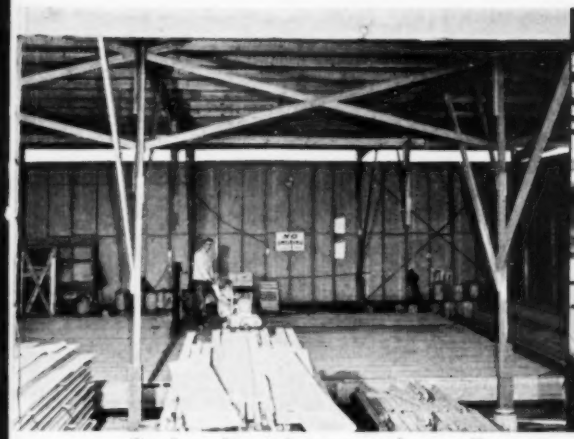
At Bakersfield, prices range from $4,700 for a "standard" one-bedroom house to $8,550 for the largest "de luxe" three-bedroom model. Translated into price per square foot, they range from $7.77 to $8.15,

5. House moves outside, gets prepainted windows, finished plumbing. Inside walls use plasterboard.

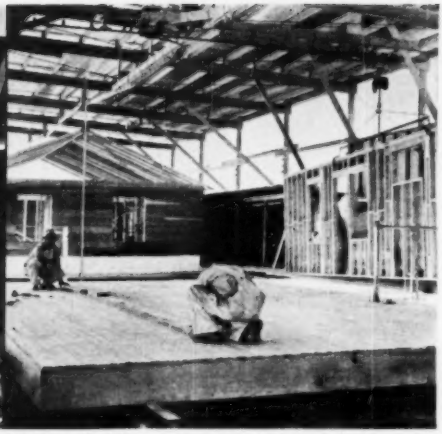
6. In sixth step, lath for kitchen and bathroom tile goes up. Cabinets, linoleum go in; walls are finished.

7. Here bathroom and kitchen are tiled. Bathroom fixtures are installed; hot-water heater is connected.

8. Next come hardware, light fixtures, last coats of paint. Baseboard trim is only part not pre-cut.



Good sanding job is easy with no walls to get in the way of the machine. Paper then protects floor. Notice materials on platforms along assembly line, simplifying the supply problem.



Hoist (holding exterior wall at right) travels on rail that has trolleylike track switch (top center of photo) so that it can carry pre-assembled wall units to any of four sides of house.

sharply lower than contractors' bids for on-the-site building. On some models, the saving has proved as much as $2.00 a square foot—which adds up to $1,000 to $2,000 per house.

The standard frame construction (double walls on 2-by-4 studding) not only meets building codes and union labor requirements; it qualifies the house for FHA and GI loans. In fact, Mobilhome construction is even heavier than codes require, since the houses must stand the strains of moving without damage. Floor joists are 2 by 12s, not the usual 2 by 8s; and braces of strong strap steel criss-cross within floors and walls.

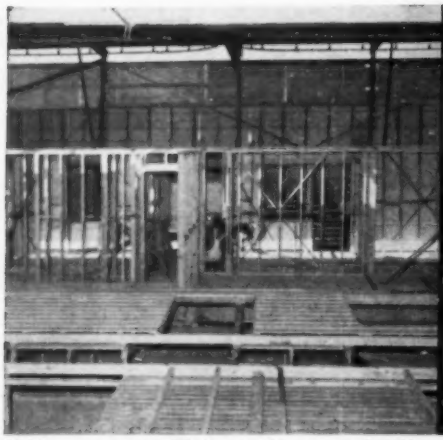
Besides this extra strength, an important factor in successful moving is the use of a tricycle, rather than a four-wheeled rig. The front end of the house being moved rests on the heavy swivel on the truck itself, and two heavy, widely spaced groups of wheels support the rear of the house. With three-point suspension, no one corner can sag. When one "tricycle wheel" drops into a hollow of the road, the whole platform tilts evenly.

Homes from the Bakersfield plant are moved up to 10 miles without extra charge to the buyer. But some have moved surprising distances. One day recently three of the homes were hauled to a ranch west of Fresno, nearly 200 miles by the side roads the mover used to avoid traffic. The rancher who bought them said they saved him "quite a bit," even though he paid an extra towing fee of $265 to $290 apiece. Other Bakersfield models have moved speedily and smoothly through tough mountain routes to coastal Santa Barbara County. Some have navigated plowed fields to reach country sites; some have been jacked up on cribbing and slid neatly into hillside lots.

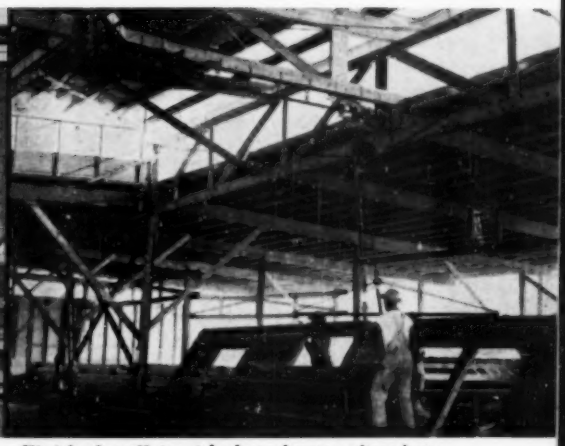
Moving a finished house within the local, 10-mile radius costs Curran $90. The extra-heavy construction also adds to the cost of the Mobilhome. But assembly-line construction brings savings that far exceed both these items, Curran reports. The Mobil-

9. In ninth step, floors are given final, fine sanding, finished, waxed. Completed house is now locked.

10. In final step, house is lowered onto truck, which delivers it, ready for occupancy, to owner's lot.



Walls are assembled on jig at work-table height beside line (foreground). Studs fit in notches in jig and siding is nailed on. Walls at rear have steel bracing instead of 2 by 4s.



Finished wall is picked up by traveling hoist for placement. To prevent sagging at this step, two 12-ft.-spaced hooks lift wall by its plate (horizontal part that supports roof rafters).

home plant in Bakersfield employs an average of only 55 persons, including office workers and salesmen, yet can turn out a house a day.

Curran's moving assembly line carries ten houses, and each home completes its journey down the assembly line in ten days. Moving it and setting it up on its foundation requires less than a day, so the buyer finds himself living in his new home within two weeks after its construction is begun.

The speed of construction cuts costly inventories. In most cases, materials are brought to the plant as used, and the completed house is sold before the materials bills come due. Thus, says Curran, Mobilhomes "will reflect instantly any drop in materials as well as labor costs."

Curran's parent corporation retains control of quality. Another powerful check on quality is the buyer himself: for this is a home-town house factory. The buyer can go see the houses being built, see the quality of the lumber, inspect finished models, and talk to people who live in them. His house is begun when he signs an order, arranges financing, and makes a down payment.

The buyer can not only choose one of several sizes, but pick which he prefers of several exterior variations offered in each size. Such things as bathroom and kitchen tile and paint colors also are at the buyer's option. Automatic gas heat, automatic water heaters, and air-conditioning ducts are installed in all models.

The Bakersfield plant has turned out houses as large as 26 by 48 feet, and still builds an occasional larger job in two units. Recently it provided a house 68 feet long—by turning out a 48-foot house, a separate sewing-room and garage unit 20 by 30 feet, and joining them at the site.

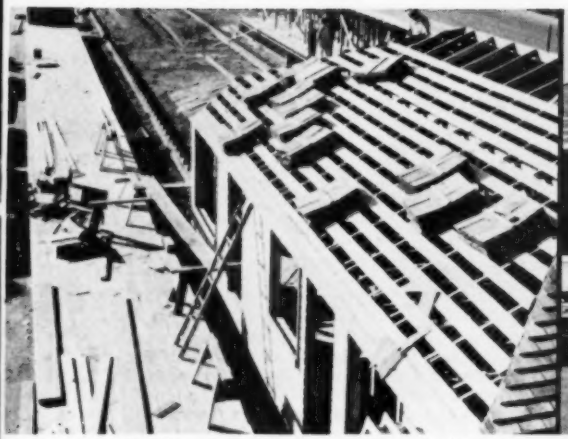
Face-altering changes are made easily on the Mobilhome production line. It's merely a matter of laying down different templates or patterns, over which wall sections are built. The buyer gets the most for his money, of course, when he sticks to the standardized models and their standardized variations of roof, siding, and paint job.

How the Houses Grow

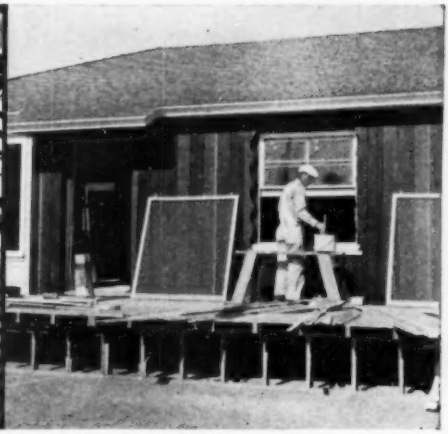
Rarely do two houses on the production line look alike. And, Curran points out, they usually go to widely separated building sites—a further guarantee against the peas-in-a-pod similarity of the houses in some mass-built subdivisions.

But let's go along and watch as the buyer follows his house down that moving line.

He sees, first of all, two lines of small but heavy rollers. These parallel lines are 18 feet apart and nearly 600 feet long. Each line is like a low, concrete foundation wall. On top, at two-foot intervals, are small, heavy steel wheels—like the casters from an office safe, turned upside down. A row of ten houses moves along on these rollers like one long train. The moving houses are separated by four-foot platforms (also moving) so work-



Roofing job, like many others, is done by a specialist subcontractor. Typical of production speed attained is this nearly complete shingle application that was finished in eight hours.



These factory-built homes are not all alike. Model above has vertical redwood siding, decorative frame around window. Other variations from "standard" models are also easily made.

ers can get between them. And along each side of the production line are permanent platforms extending the full length of the line, more or less like boat docks.

Nearly half of this assembly line is indoors—covered by a huge, metal-roofed shed, left open at one end so the houses can move right on out. Construction begins, of course, at the indoor end of the line, where the joists are laid on two pieces of channel steel, as long as the house. These steel rails ride on the rollers smoothly, and, since they're shaped like an upside-down U, can't slide off to either side.

Watch the pre-cut materials flow smoothly together into a heavy, solid floor platform and you'll begin to see where the savings come in. There's never a lost motion, hardly a pause in the work. Everything fits as it comes from the power saws nearby. And each man is a specialist at his job.

Even the pauses pay off in efficiency. A few of the workmen step outside for a cigarette. If you think they're wasting time while they smoke, look again. They're studying a big blackboard that shows them the varying design of each house on the line. "We could give them charts to study on the job," Superintendent Jim Bird explains, "but they'd still want to step out for a smoke now and then."

Once the house has passed the point ➧

Tricycle dolly that carries house to permanent location is backed into this 3-ft.-deep pit at end of production line. Jacked-up house is then lowered onto dolly and fastened down tight.

Using side roads, truck moves house at 30-m.p.h. speed. Dolly is backed over end wall of foundation; house is jacked up while dolly is pulled out; then whole unit is lowered into place.

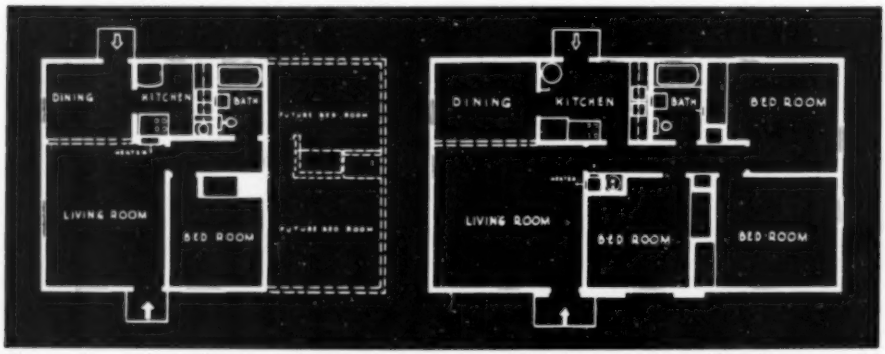
Owner can move in within few hours—as soon as joists are nailed to foundation sills, the utility connections made, skirting board applied, and the decorative trim added and painted.

in the line where its roof goes on, it moves out of doors. In chilly weather, a heavy hose with a railroad-style coupling feeds natural gas to the house so its own furnace can be used to heat it. "No use having men fumble around with numb fingers on cold mornings," Bird explains. Such comfortable working conditions are one big reason union labor likes these jobs. And in addition to top wages, convenience of the permanent location, and the comfort of working indoors, there's a powerful added factor—steady work.

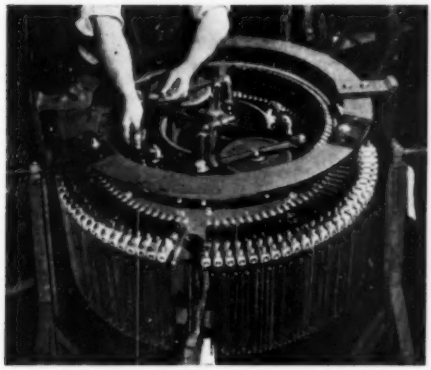
Loaded on its tricycle trailer and hitched onto a big truck, the house moves down the highway at the mover's customary 30 miles an hour. At the owner's lot, a foundation already has been completed by a subcontractor. (His fee, like the mover's, is included in the price of the house.) The truck delivers the house by backing it over the end wall of the foundation on a ramp of heavy blocks, jacking it up, withdrawing the truck, and lowering it to the foundation. If there isn't room to approach from one end, the house is jackknifed into position in front of the foundation and parallel with it. Then it is jacked up on a cribbing of heavy timbers, the truck rig withdrawn, and the house pulled by winch and rollers onto the foundation and lowered.

Floor joists are toenailed stoutly to the redwood sills on the foundation. Sewer and gas and water connections are made and tested. A skirting board (bottom row of siding) extending down over the top of the foundation is put on; pre-assembled trim is nailed to the four corners of the house; and a painter applies the final coat to skirting and corners.

And there goes the owner, lugging in his first groceries—about six hours after his house left the factory! END



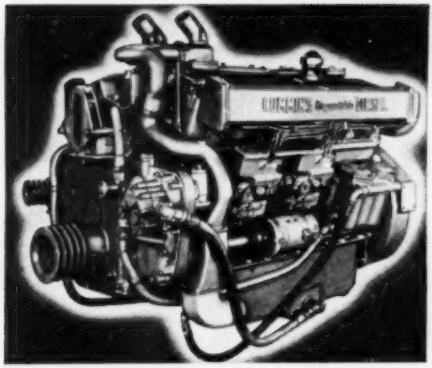
Floor plans of smallest and largest Mobilhomes® show simple, functional layout. Houses intended to be erected in colder climates would have cellar furnaces instead of space heaters.



Accelerator Smooths Rides

DESIGNED to provide greater riding comfort by eliminating jerky starts and stops, this Westinghouse accelerator will soon be placed in operation in the latest type of streetcars. It operates like an automobile distributor, with 99 closely spaced contacts.

When the operator steps on the accelerator or brake pedal, the X-shaped arm revolves, and the two wheels press down the contacts. The many contacts vary the electric power fed to the driving motors in close "steps," changing speed gradually.



Compact Diesel Packs Punch

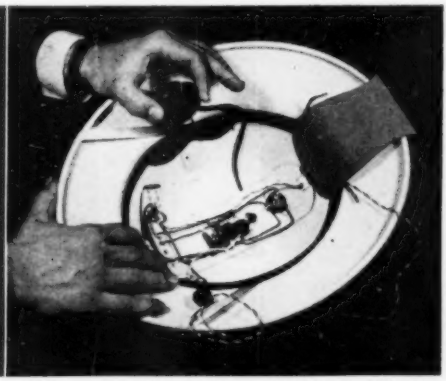
ONE of the world's most powerful high-speed Diesels—developed during the war—is now in mass production. The 550-hp., supercharged engine is being used in heavy-duty, off-the-highway dump trucks, excavating machines, and switching locomotives. Weighing 4,450 lb., it occupies a space of only 73 by 41 by 57 in. Two banks of six cylinders each are staggered in a 40° V.

The manufacturer, Cummins Engine Co., of Columbus, Ind., reports that the new engine's uniform torque reduces shifting.

Sun Hat Has Built-In Radio

No, that's not Buck Rogers. It's just Victor T. Hoeflich and his Radio Hat®. The hat works, too—it keeps the sun off your head while you listen to radio programs. The Radio Hat contains a real radio receiver—two miniature tubes, the volume control, and the antenna (which looks like an oil-can handle) stick out on top. The rest of the circuit is inside the hat's lining.

The hat weighs only 12 oz. The 7-oz. power supply—a flashlight cell and a B battery—is carried in the pocket. Mr. Hoeflich's company, American Merri-Lei Corp., Brooklyn, N. Y., makes the talking benny.



Inventor Hoeflich demonstrates his helmet-with-a-radio-inside (left). Tubes, antenna, and volume control are on top. At right, he lifts the lining to show the remainder of the radio circuit.

Future Planes Fly Before They're Built

Powered scale models, radio-piloted, save thousands of hours and millions of dollars in design of flying boats.

By Andrew R. Boone

BARELY skimming the placid salt water of a narrow estuary off San Diego bay, the plane's knifelike bow rises gently. Four engines, buzzing like angry hornets, pull the seaplane into a climb. Straightening out a hundred feet up, the plane flies on even keel for a quarter-mile, swings into the wind, slowly descends. Suddenly the props cease whirring, down comes the tail, and she's on the surface. Then a man wades out, grabs her tail, and casually pulls her ashore.

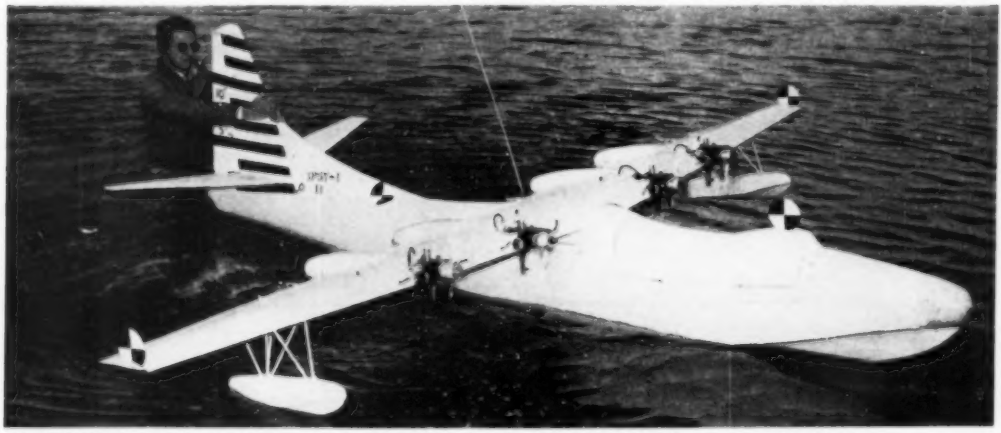
For this radio-controlled version of the Navy's XP5Y-1 is just one-tenth the size of her prototype—which won't be airborne for several months.

Racing down the same straightaway, the twin hulls of another mighty midget cut through whitecaps kicked up by the rising spring breeze. This one, too, skims the surface, soon rises sharply. Critical eyes observe each move as she climbs, swings about, alights safely. A movie camera records every buffet, every twist, as the instrument-crammed hulls slap water.

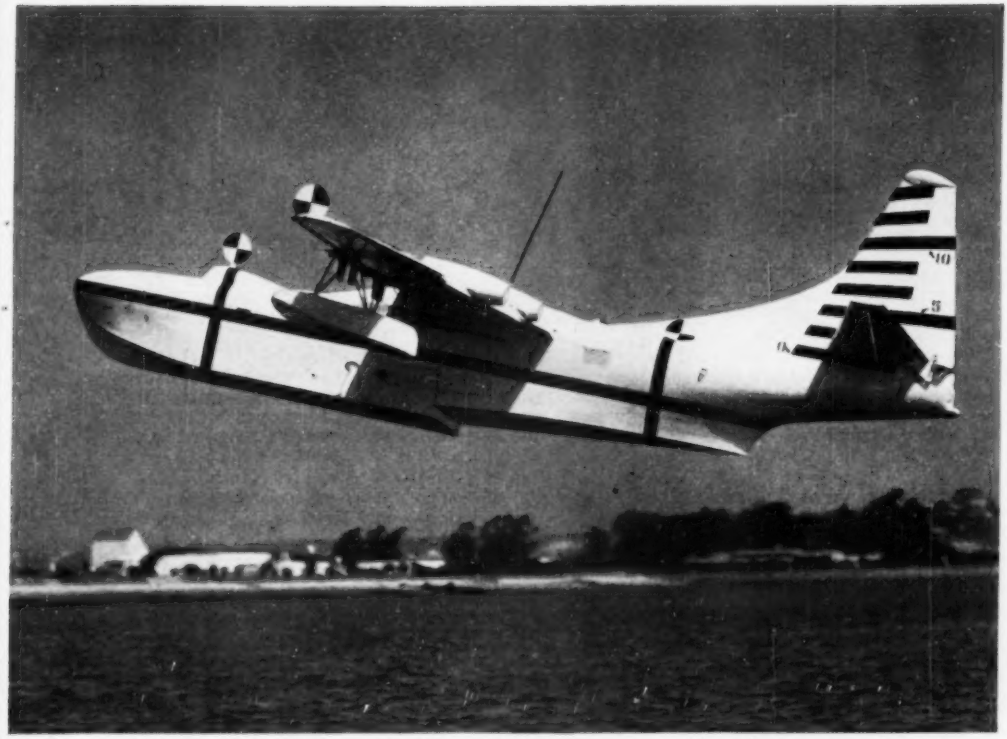
This is a giant twin-hull seaplane, in miniature. One day her tremendous hulls may transport 300,000 pounds of men and goods across the seas, at speeds greater than any land-based transport achieves today.

Perfecting an airplane once was a job costing millions. Now the bugs can be ironed out of a new design by flying a low-cost radio-controlled model. Except for the difference in size, the little one and the big one are as alike as two peas in a pod. When the XP5Y-1, projected to cruise at 350 miles an hour, takes to the air on her maiden flight, she already will have been checked out on the narrow lagoon. Should hull changes be required, they first will be applied to her baby counterpart and water-tested, eliminating danger to the crew and saving the high costs of usual flight testing.

This sleight-of-hand with baby planes is performed by a hand-picked crew of the



The XP5Y-1—scaled to 1/10 the real thing—has four 1.5-hp., two-cylinder engines. Each burns 1.5 ounces of fuel a minute, and swings an adjustable-pitch propeller two feet in diameter. The plane weighs 123.5 lb., and is built of balsa, mahogany, spruce, tissue paper, aluminum, steel, and plastics. It cost $50,000, and has flown hundreds of times during tests.



Take-off of free-flight model of an XP5Y-1 flying boat is controlled by radio located on shore. Seven audio frequencies permit simultaneous and independent control of flaps, ailerons, rudder, elevator, two throttles, and ignition. Control is effective up to 3,000 feet. If plane flies beyond that distance, it automatically banks left and returns within range.

Ground crews handle their miniature charge with ease. For hauling in and out of the water, the models are cradled in the "mud-mobile" shown above, a steel frame on two large rollers.

Tiny copper gas tanks are filled through a rubber tube leading from a small can. Fuel mixture consists of 80-octane gasoline and S.A.E. 70 oil—four parts gasoline to one part oil.

This twin-float model is the forerunner of tomorrow's giant twin-hull flying boats. The same set of wings and tail have been used to test 29 hull configurations. Because models react faster than full-size planes, they're built extra tough to withstand rough landings. When the real thing is built, it will be capable of hauling 300,000 pounds of cargo over long distances.

Consolidated Vultee Aircraft Corp. The models, built to scale, reproduce every motion and force of the full-scale planes under the same sets of conditions. A designer can build a model and try a thousand different modifications in six months—for peanuts.

Midget test models are the responsibility of Ernie Stout, Convair engineer in charge of Navy developments. He started his first model in 1943. Into it went a pair of opposed, twin-cylinder, 1.6-hp. engines, which reproduce to scale the power and thrust of the big Cyclones®. Electric servos to handle the controls were developed in his shop. Automatic mixture control was devised to prevent loading and stalling when throttles were closed. His wizards came up with a seven-channel, airborne radio receiver weighing less than 15 pounds. Up came a portable transmitter.

In five years, Stout's boys have conducted 3,000 flights. Once, they logged 185 runs in three busy days. Motion-picture records of each run reveal exactly what improvements result from a change. When you view a sequence, you see at reduced size a plane

Shore-bound "pilot" handles radio-controlling transmitter built in form of a full-size seaplane flight deck. The transmitter is four-stage, crystal-controlled, and has an output of 63 watts.

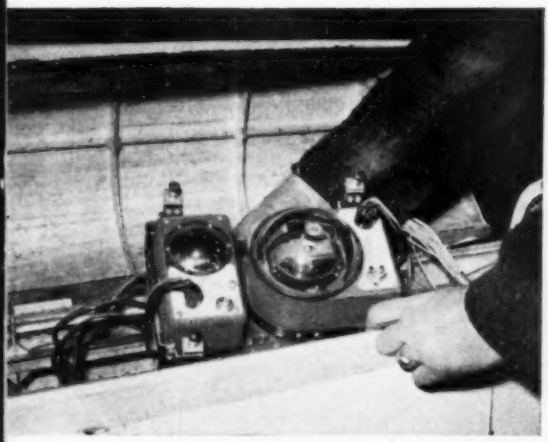
For greater accuracy, more recent development requires two pilots, each with a control box. Pilot at left, with two sticks, operates ailerons. The other handles rudder, elevator, ignition.

This unpowered, conventional flying-hull model is launched from a target-drone catapult, and is radio-controlled in flight. A spring mechanism shoots it aloft in simulated flight attitude after a 20-foot run. Used for measuring hydrodynamic forces, the model is 1/15 scale. It is 13 feet long, stands 4.5 feet high, and has a span of 14.6 feet. It weighs 112 pounds.

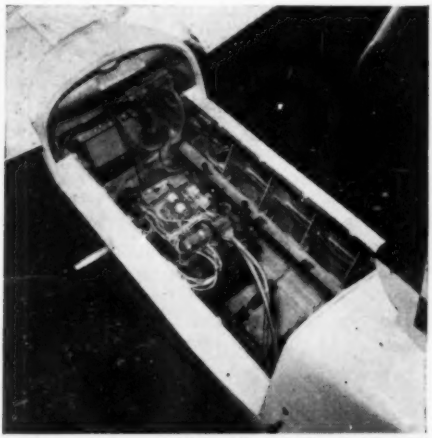
of the future. "No need to gamble ten million dollars," says Stout. "Here's the airplane, ready to fly."

Accidents are inexpensive. Recently the twin-hull job, unexplainably porpoising on take-off, straightened out momentarily at 30 feet. From his radio station ashore, the pilot opened his throttles. There was brief promise that increased power would pull the plane out of trouble, but the coal was poured on too late. The left wing dropped off in a quick spin, and after one turn the model smacked the water on a wing tip. Three days later, the plane was flying again.

Stout considers the XP5Y-1 the beginning of a revitalized program leading to fleets of water-based planes. In the past, both pontoon seaplanes and the flying boat have suffered speed penalties of 100 to 200 m.p.h. under landplanes. Now, as a direct result of his experiments with the toylike models, exactly the same kind of performance can be designed into water-based and land-based planes. He doesn't start with a boat and try to make it fly. He begins with an airplane and makes it work on water. END



A tiny, 5.5-pound autopilot keeps the models on even keel during flight. It makes corrections for sudden changes in attitude before pilot ashore can react through his controls.



Radio receiver used in all models consists of filtering, modulation, and relay circuits. The unit, weighing less than 15 pounds, may be moved to alter the model's center of gravity.

New power plants to make more fuel than they burn.

U.S. to Breed Own Atoms

By Volta Torrey

"OPERATION BOOTSTRAP" is an attempt to build an atomic power plant that will manufacture *more fuel than it consumes.* This would be like heating your home with a furnace that turned water into oil so readily that you never had to buy oil, either for the furnace or your car.

This sounds as crazy as eating your cake while baking it. But *it is now theoretically possible for a nation to multiply its supply of fuel while using it.*

The Atomic Energy Commission has started Operation Bootstrap by ordering two "breeders" built. They will be nuclear reactors that, if successful, will produce simultaneously:

1. *More fuel for more atomic engines.*
2. *Heat convertible into electricity.*
3. *Isotopes as useful as radium.*

These breeders will be test models, representing only two steps toward the development of power plants capable of generating millions of kilowatts while manufacturing fuel for ships, airplanes, and rockets. There is no more reason to doubt now that such plants can be built than there was in 1940 to doubt that an atomic bomb could be made. But questions about the best way to do it, the hazards and costs, cannot be answered yet. These breeders will be built to end those misgivings.

Neutron Speeds Are Varied

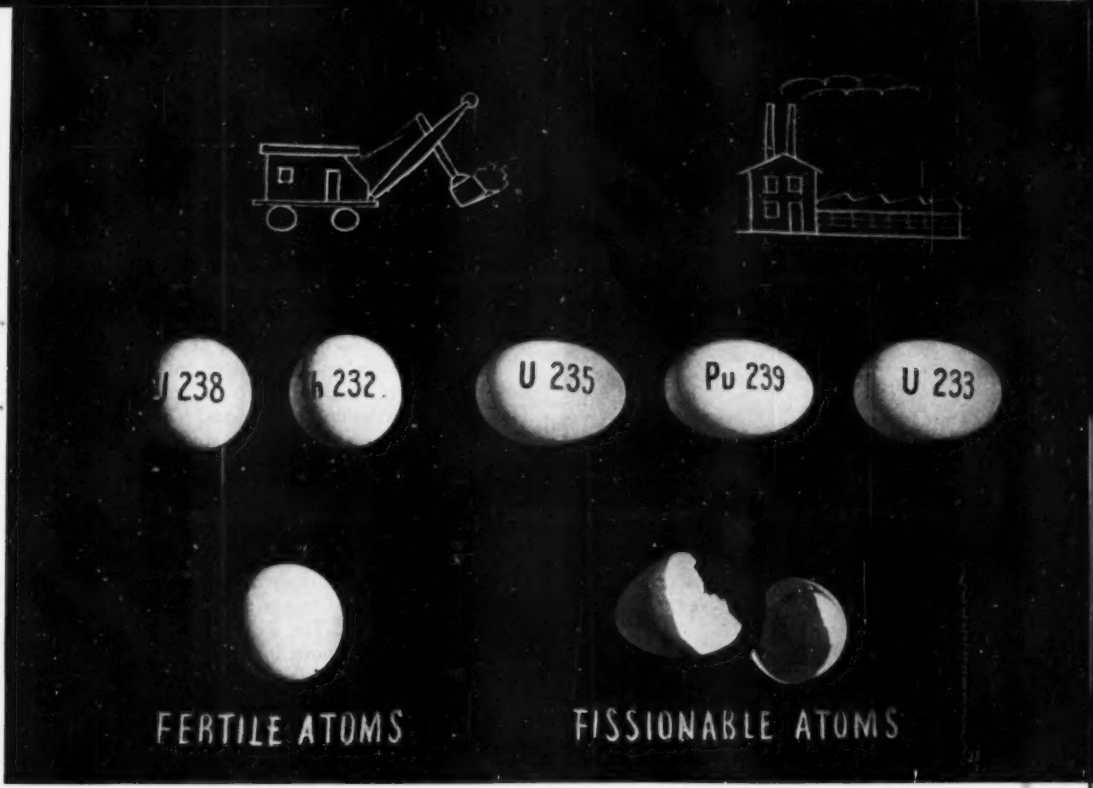
Nuclear reactors are called fast, slow, or intermediate, according to the velocities at which neutrons generally are used in them to split atoms. A slow neutron is one that is only going about as fast as the fastest airplanes ever built; a fast neutron is one that is traveling a million or so miles an hour. The piles that you have seen pictured in POPULAR SCIENCE are slow reactors ("How to Run an Atomic Power Plant," Feb. '48, p. 128; "U. S. Lights New Atomic Pile for Peace," April '49, p. 121).

The first breeder tried will be an intermediate-speed reactor, and the second one will be a fast reactor. Construction of the intermediate-speed device is scheduled to begin this year. General Electric will build it near Schenectady, N. Y., for the Knolls Atomic Power Laboratory. It is expected to cost $18,000,000, and completing it will take about two years. It will be the first intermediate-speed reactor ever erected.

To Breed at High Speed

Building the second, faster breeder may take at least a year longer. Designers at the Argonne National Laboratory near Chicago have been working on plans for it for about two years. A fast reactor that will not explode has been running for some time at Los Alamos, but it is such a little thing, as reactors go, that it has been called a watch-fob model of a future atomic engine. The big fast reactor that the AEC now has ordered will probably be placed in the new reactor-testing station about to be established in Idaho. It will be a source of both power and more fuel.

Physicists call nuclear fuel "fissionable" material and refer to the stuff from which it can be made as "fertile" material. By fissionable material, they mean something consisting of atoms that will not come apart naturally for a long time but that can be broken by a slow neutron.



Only three fissionable materials, or fuel for atomic power (symbolized by eggs in picture above), have so far been discovered. And only one can be dug from a mine. The other two must be manufactured in an atomic pile from naturally occurring fertile atoms (balls).

Only three kinds of atoms like this have been found. They are those of

Uranium 235 Plutonium 239 Uranium 233

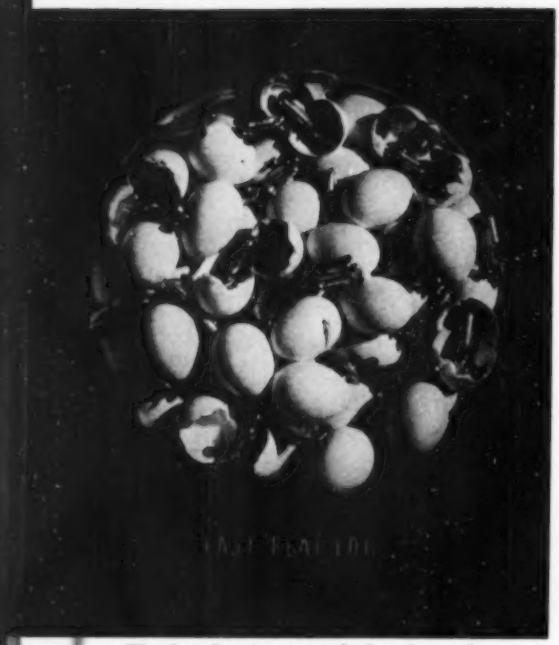
These are the three known fissionable materials. Only one of them, Uranium 235, can be dug out of a mine, and it is not only scarce but also difficult to separate from other uranium. The other two nuclear fuels, Plutonium 239 and Uranium 233, have to be manufactured from fertile material.

There are two fertile materials in the earth's crust. They are

Uranium 238 Thorium 232

Both are comparatively plentiful and less difficult to obtain than Uranium 235. So,

Fertile atom can be changed into fissionable atom by neutron (represented here by tiny car) of right speed. The neutron is absorbed by the atom's nucleus. Fertile atom then undergoes radioactive changes—wheels indicate emission of beta particles—and becomes fissionable.



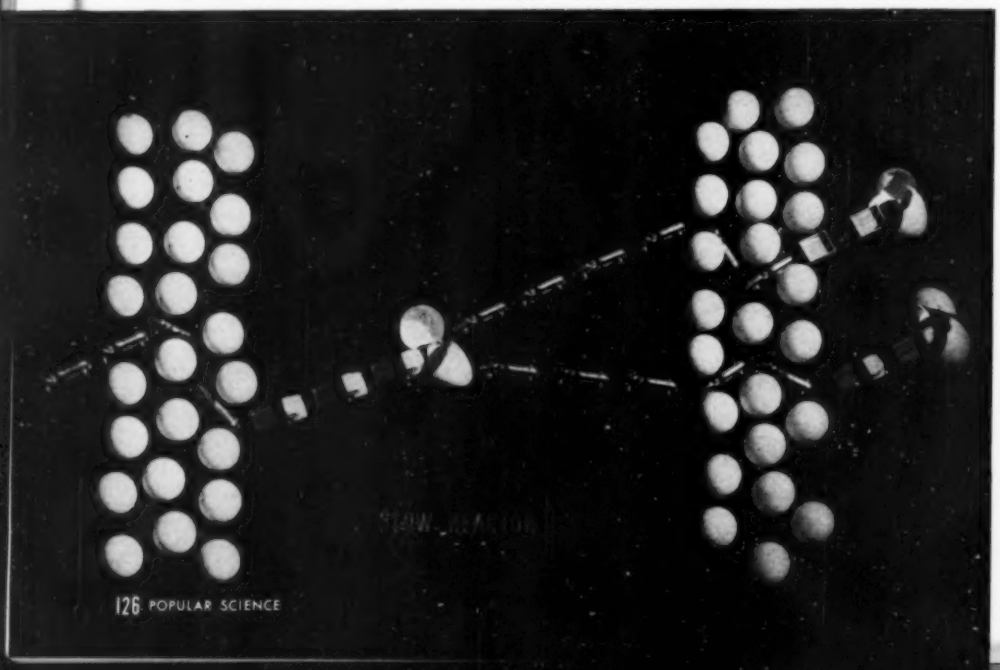
The bomb acts extremely fast, but a fast reactor is not necessarily explosive—any reactor that uses neutrons without slowing them is called fast. In bomb, so many neutrons (tiny cars) are confined in so little space with so many fissionable atoms (eggs) that explosion results.

whether we want more bombs or more industrial power from atomic energy, we are likely to find it worth while to make much of our nuclear fuel out of these fertile materials. One kind of fissionable material, Plutonium 239, can be made out of Uranium 238; and another kind of nuclear fuel, Uranium 233, can be made out of Thorium 232.

You can step into your kitchen and see the difference between fissionable and fertile atoms. Let some water splatter into the sink so that big drops cling to the enamel. Then take a medicine dropper and let some droplets fall on a few of those big drops. You will find that your droplets are more likely to break a big drop that is long and narrow than one that is nearly round. In the lingo of physics, the elongated drops are more fissionable than the round ones.

The nuclei of the three fissionable and two fertile materials' atoms resemble those big drops of water. The fissionable atoms' nuclei seem to be more lopsided and less nearly spherical than those of the fertile atoms. This difference in shape explains—as well as any mathematical process that men have been able to devise—why the fissionable atoms usually come apart but the other two usually do not when hit by slow neutrons.

In a slow reactor, the fast neutrons (racing cars) are slowed down by their collisions with the sturdy atoms of a "moderator" (balls). The slow neutrons (trucks) are then used to split more atoms and thus maintain the chain reaction. All controllable reactors built thus far, except for one at Los Alamos, have been slow, using graphite or heavy water as the moderator.



By glancing at the five atoms' names, you can see why they are believed to be shaped differently. The numbers after the names show how many nuclear particles—protons and neutrons—each of these five kinds of atoms contains. All five are large numbers, but, as you may have noticed, the numbers after the fissionable materials' names are *odd* numbers whereas those after the names of the fertile materials are *even* numbers. Each of these five kinds of atoms has an even number of protons in it, so the final number means that the fissionable nuclei contain odd numbers of neutrons and the fertile materials' nuclei contain even numbers of neutrons.

Why the Shapes Differ

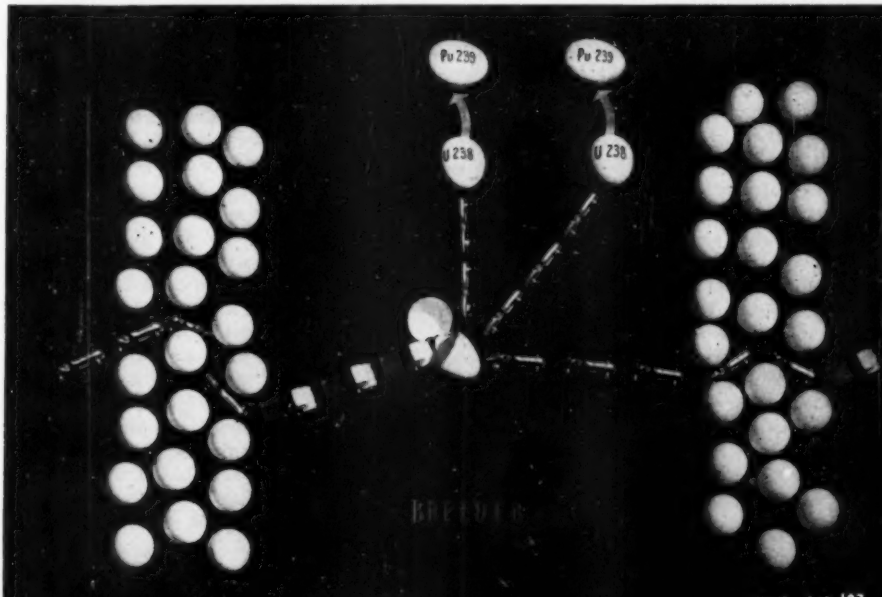
The protons see to it that the nucleus is less spherical when the number of neutrons is odd than when it is even. As you've heard many times, no doubt, each proton has a positive electrical charge. These charges make the protons tend to stay as far apart from each other as they can. Some of them get farther apart from some of the others when they are confined in a nucleus with an odd number of neutrons than they can when they are locked in with an even number of neutrons.

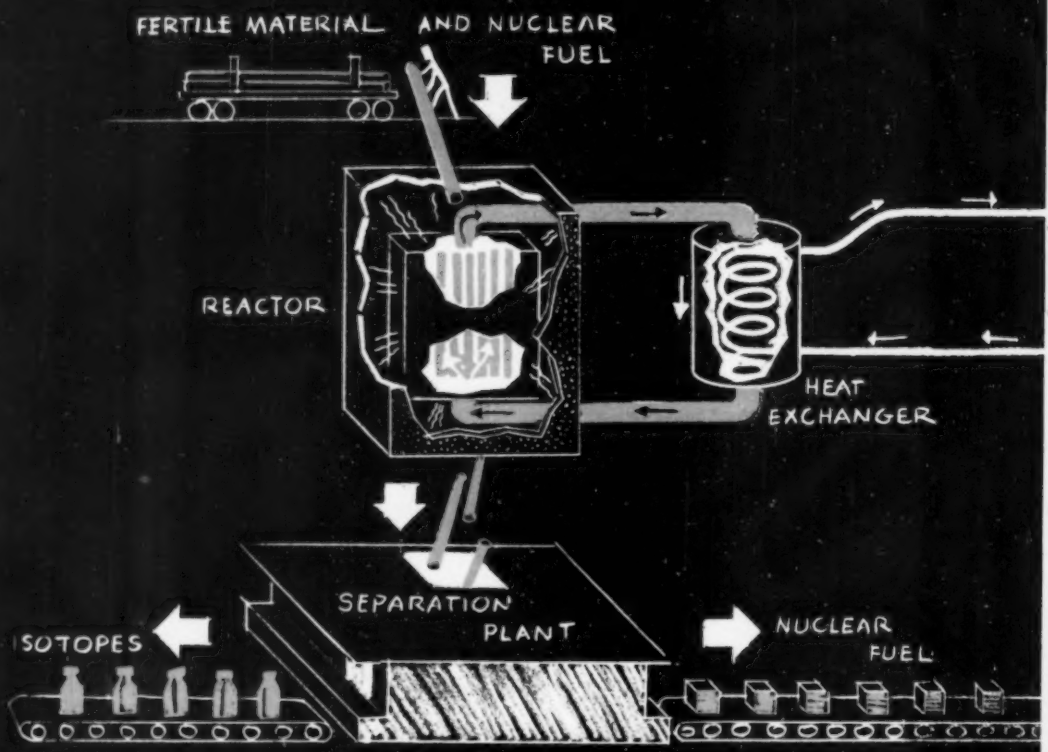
To make a fertile atom elongated enough to become fissionable, all you have to do is put another neutron into its nucleus. But how would you go about such a delicate and difficult operation as putting another invisible and only indirectly detectable particle such as a neutron into a nucleus that is satisfied with an even number of neutrons?

Ten years ago two refugees from Germany, O. R. Frisch and Lise Meitner, guessed that hitting an atom of uranium with a neutron would sometimes split it. At a meeting in Washington, Enrico Fermi then guessed that more neutrons would pop out when a uranium atom was split. And that gave scientists the idea of splitting some atoms of uranium to obtain more neutrons to drive into other atoms of uranium that were fertile but not fissionable. This was done, and nuclear fuel made out of fertile material was used in the bomb that was dropped on Nagasaki.

Splitting other atoms is still the only feasible way known of obtaining big batches of free neutrons that can be added to the nuclei of fertile atoms. Suppose you were to smash a pound of fissionable Uranium 235 atoms. You would obtain about one-sixth of an ounce of free neutrons. Most of them would start out extremely fast. Some would hit and break other atoms.

In a breeder, one of neutrons released by each atom that is smashed will be used to continue the chain reaction, as usual. But other neutrons will be used to convert fertile atoms into fissionable atoms, as indicated below, where two are diverted for breeding purposes while another goes on to continue reaction. Two experimental breeder reactors are planned by AEC.





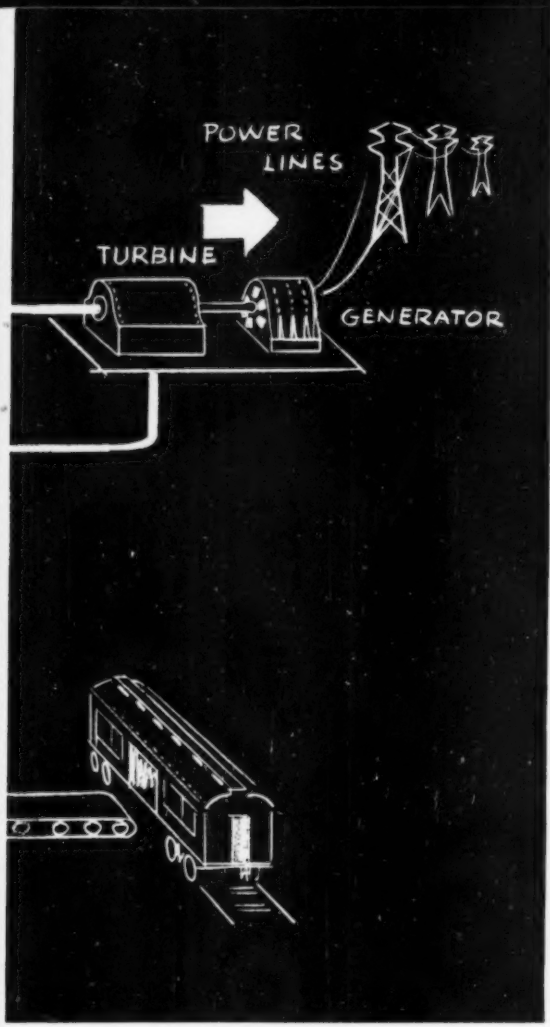
THREE PRODUCTS FROM ONE REACTOR

Others would bump into sturdier nuclei and such collisions would slow the neutrons down. Many would slip right into other nuclei and stay there.

A free neutron's chances of slipping into a fertile atom's nucleus depend mainly on its speed. The neutron may break the fertile atom, rather than slip in, but this is not likely enough to happen to permit fertile materials to be used as fuel for a chain reaction. The neutron also may recoil from the fertile atom, the way a rubber ball bounces back from a wall. But if the neutron hits the fertile atom at a certain speed, it is likely to be absorbed by the atom and become a part of its nucleus.

This speed is called the "resonance" speed. It is one at which the neutron can get into step with the vibrations of the fertile atom's heart. Several different speeds may be resonant, but the neutron must be moving at one of them to enter the atom's nucleus. If the neutron is too fast or too slow, it will not get in. But whenever a neutron hits a fertile atom at a speed that is resonant for that atom it is absorbed by the fertile atom's nucleus.

Quite literally, the result is a dance of death. Absorption of a neutron by an atom of Uranium 238 makes it an atom of Uranium 239. Before Uranium 239 is many minutes old, it becomes Neptunium 239 and within a few days this decays into Plutonium 239, which is a fissionable material. Thorium meets a similar fate when it admits a neutron to its heart. First it becomes Thorium



233, then Protoactinium 233, and finally Uranium 233. This aging process in thorium, however, takes about ten times as long as in uranium.

The names change while the fertile atoms are growing older and becoming fissionable material because their radioactivity changes the number of protons in them, but the final figures remain odd numbers. So, in each case, the result is the transformation of an atom that previously could not be used as nuclear fuel into one that is elongated enough to serve as fuel for either atomic bombs or atomic power plants.

Works Easier Than Expected

Two discoveries during the war surprised the scientists. They were surprised to find how *easy* it was to establish a nuclear chain reaction, and how *easy* it was to turn Uranium 238 into Plutonium 239.

Plutonium 239 was made in the big plants at Hanford from material that contained both Uranium 235 and Uranium 238. The Hanford reactors transferred neutrons from the odd-numbered fissionable atoms to the even-numbered fertile atoms. Thus they made one kind of nuclear fuel out of another kind—and enabled the United States to load its bombs with either one of two of the three known fissionable materials.

Saving the Neutrons

But the Hanford plants were not breeders because they did not produce any more pounds of Plutonium 239 than they consumed of Uranium 235. The breeders are expected to turn out greater quantities of fissionable material than are needed to keep them running. And whereas the heat from the Hanford plants is lost, the heat from the breeders is to be used to generate electricity.

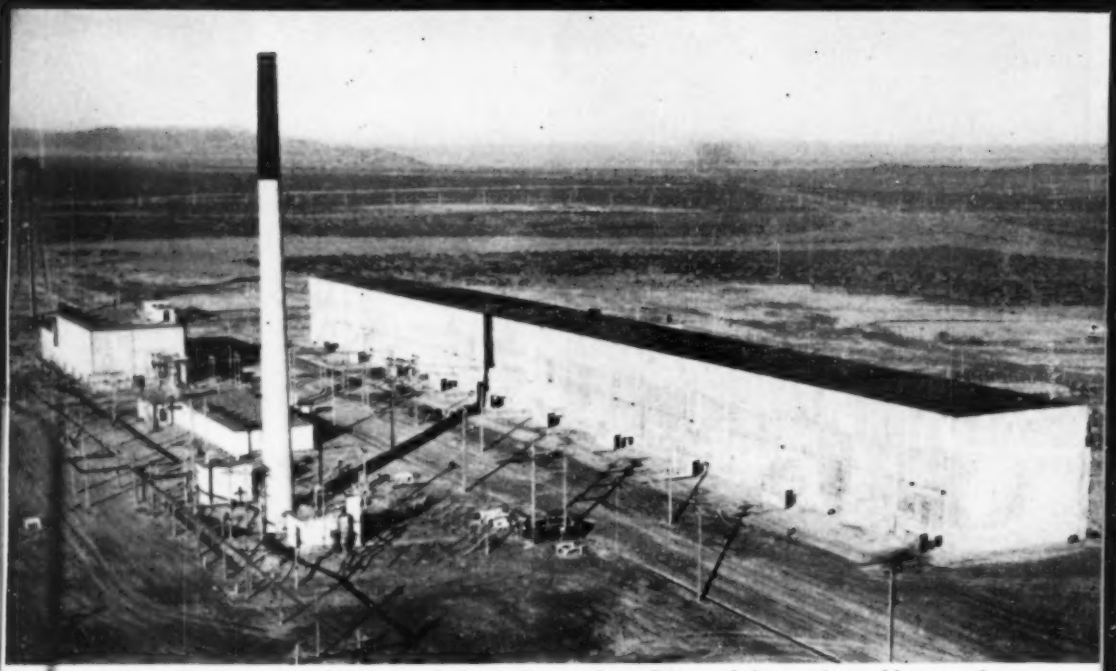
If you neither lost nor wasted any neutrons, you would need only one neutron per atom to split every atom in a pound of fissionable material. You then might have at least twice as many neutrons to work with as you would need—assuming that you were fantastically super-duper at the job—to split a second pound of atoms. So you could use the extra neutrons to do something else. That's the big idea in a nutshell.

Neutron Traffic Control

In both of the breeders to be built for Operation Bootstrap, some of the neutrons freed when atoms are split will be used to split more atoms. Others will be employed to elongate fertile atoms. This is to be done by controlling the neutron traffic more efficiently than the builders of the Hanford piles tried to control it.

This neutron traffic problem, however, is much bigger and more complex than the one posed by the cars in New York City's streets. It entails the control of far more neutrons than any city has cars, going much faster, and headed every which way.

The makers of the bomb deliberately designed a reactor in which the worst possible neutron congestion would occur in the least possible time and space. They did this so well that their bombs splattered nuclear energy all over the countryside.



Plants like this—one of the original chemical-separation buildings at the Hanford plutonium works—will be needed to get fissionable material out after it is manufactured in the breeder.

In other nuclear reactors, however, the neutron traffic has been firmly controlled. This usually has been done both by slowing down the neutrons and by keeping them from becoming too numerous. Their speed has been reduced by placing "moderators," which function like a maze of traffic circles, in their paths. The neutrons bounce around amidst the atoms of these moderators until they lose much of their energy. And the volume of the neutron traffic has been curtailed by inserting materials that soak up neutrons as readily as a sponge absorbs water.

Heat Will Make Power

In the breeders the number of neutrons will be kept small enough to avoid trouble, but they will not be slowed down as much as in the first reactors built. And the traffic problem is to be dealt with in a way that also may make it easy to utilize the heat from the nuclear chain reaction to produce power.

When an atom is split, the things in it fly apart with tremendous velocity. They hit other things. This turmoil yields what we call heat. The velocities of a smashed atom's parts correspond to billions of degrees of heat, and this heat must be let out to keep the whole apparatus in which such things happen from melting. The more efficiently the heat can be removed, the more efficiently the neutrons in the reactor can be employed. And if the heat can be taken out fast and safely, it can be turned into electricity.

Liquid Metal to Cool Them

There are many ways of removing heat. At Hanford the Columbia River was used and care was taken not to raise its temperature enough to bother the fish. In both of the breeders now in the works, liquid metal will be used as a coolant.

A metal, bismuth, was considered while the Hanford plants were being built, but water was chosen instead to save time. Since bismuth "freezes" at 520° F., it would have to flow in at a higher temperature and come out even hotter to serve as a coolant. Whatever the liquid used to cool these piles is—and considerable work has been done on this aspect of the problem—it is likely to come out at temperatures more suitable for the generation of power than that of the water now coming out at Hanford.

Suppose that you had a gasoline engine that ran best when it was so hot that you had to use a liquid metal instead of water to "cool" it. The hot liquid metal coming out of the engine would have to be cooled

before it went back in. What better way would there be to reduce its temperature than to let it heat water? And why shouldn't you use the steam from the water to do something else?

Temperatures of the sort you would be dealing with in that imaginary gasoline engine are desired to breed nuclear fuel, and if they can be maintained and controlled in the breeders, the way to use atomic energy to produce steam to produce electricity may be found simultaneously.

Some Losses Are Certain

Anything used either in the coolant or the structure of the reactor is liable to soak up some neutrons and thus prevent them from being used either to elongate fertile atoms or to continue the chain reaction. Hence, some neutrons will continue to be wasted, but the breeders have been designed to reduce the losses.

Both the intermediate-speed and the fast reactor may be less wasteful than those built in wartime, but doubt as to which type will be the best breeder will persist until both have been built and operated. And although both are likely to produce useful amounts of electricity, the AEC will be surprised if those amounts are tremendous in either case.

If nuclear reactors, their products, and their debris were as safe and easy to handle as ordinary furnaces, coal, and ashes, atomic power might be available for many purposes fairly soon. But the hazards are so great that the engineers and mechanics cannot tinker much with nuclear reactors.

"Bugs" Are Expected

Soon after the breeders are started, they will become so thoroughly infected with residual radioactivity that it will be extremely difficult to take them apart and remodel or repair them. Very little maintenance work will be possible. And no one knows for sure how long even a successful reactor is likely to last.

"Bugs" are liable to be found in the first breeders—as they have been in other inventions—and the designers may have to eliminate many of them before breeder-power plants can compete with ordinary steam plants and hydroelectric dams. Troubles resulting from corrosion and violent differences and changes in temperature have become so acute since the war in some of the plants built during the war that the AEC has had to do a lot of work to keep them running.

The extra dividend of radioactive isotopes—valuable for scientific research—that will come out of the breeders along with nuclear fuel and power may prove troublesome, too. These unstable materials will have to be separated from the fresh nuclear fuel that is bred in the piles, by mechanisms and processes isolated from human beings by heavy shielding.

A 30-Year Project

So, even though breeders are now scheduled to be running within three years, the men who know most about the problem believe it will take from eight to ten years to find out whether it will be economically wise to build enormous breeders as the furnaces for electrical generating stations. Different procedures will be necessary to breed nuclear fuel from Thorium 232 than those needed to breed it from Uranium 238. And to breed enough fissionable material to make it truly plentiful will take many years.

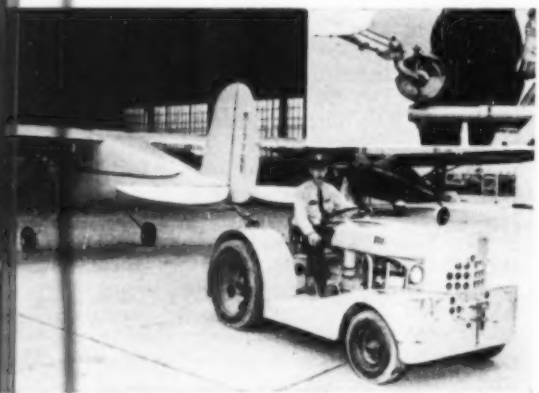
The best guess now is that from 20 to 30 years will elapse before atomic power replaces other sources of power extensively. Military necessities and security restrictions may postpone even longer the day when people will be better served by atomic energy.

Operation Bootstrap, however, will reveal how skillfully the engineers now can handle hordes of neutrons. Until 17 years ago, no one even knew that neutrons existed. Already, they have been used in both slow and fast reactors. Pretty soon, you may hear more about what can be done with them. END

Next Month: **Will Atomic Engines Be Mobile?**

What's New in Aviation

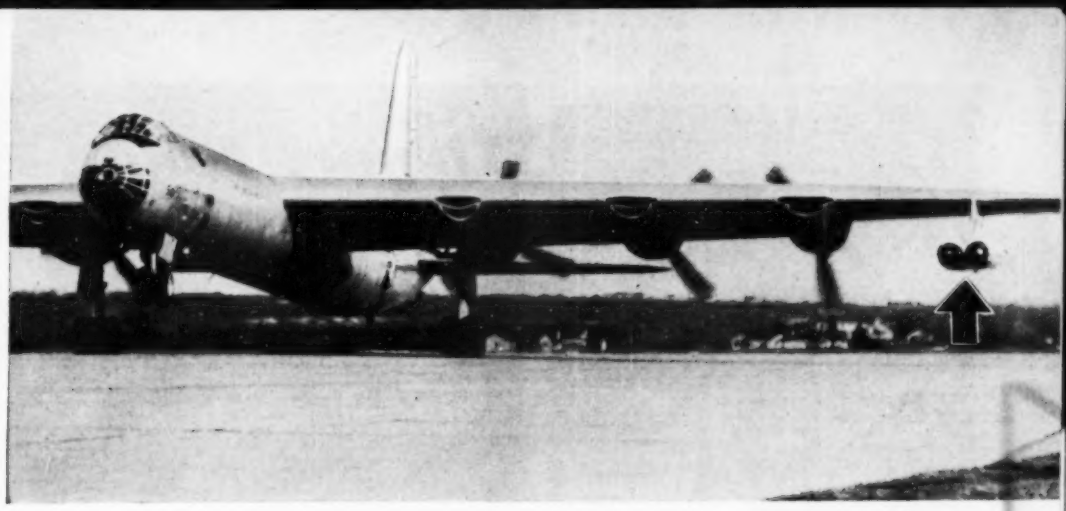
Biggest Bomber Adds Jet. The six conventional pusher engines of the giant B-36 now have the help of four J-35 jet engines (arrows) to give added take-off power and greater speed over a target. In recent trials using the two twin-jet power packages slung in outer positions under the wing, the Consolidated Vultee bomber got off the ground after 3,500 feet instead of the usual 5,000-foot run. The Air Force claims that at an altitude of 40,000 feet, a height it can maintain over great distances, the B-36 cannot be intercepted by even the fastest and most maneuverable fighters.



Tractor Tows Light Plane. Using a tractor to move light planes, above, not only saves time and manpower, but protects the craft from damage. Towing a plane by hand, or using a dolly, takes two men. With the tractor device, invented by an Oakland Municipal Airport employee, one man just lifts the tail wheel about two feet, fits it into a swiveled cup (see inset), locks it in place with a hinged clamp—and drives off.

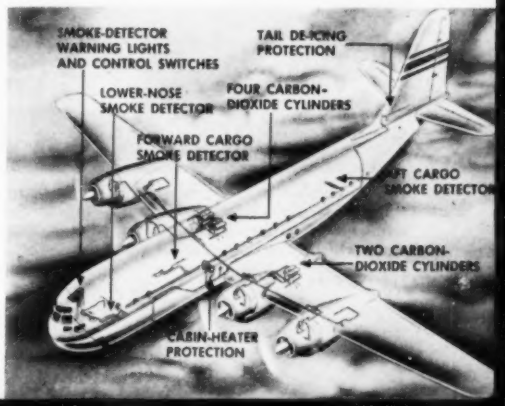
Tiny Motor Does Big Jobs. High speed, small size, and light weight are combined in this servo unit made by the Kollsman Instrument Division of Square D. The 400-cycle, 115-volt AC motor is 1¾ in. in length and diameter, and weighs only 6.1 oz. Reversible in .2 sec. from 11,200 r.p.m., it is adapted for servo systems in aircraft computers, auto pilots, radar and searchlight directors, and fire-control gear.

Trainer Has Safety Cockpit. This is where future Air Force pilots will learn how to fly. It is the functional cockpit of the Fairchild T-31 (a modified Navy XNQ trainer) chosen by the USAF for primary and basic training. For quick identification the flap lever is a tiny flap; and the handle of the landing-gear lever, a small wheel. Location of controls and instruments is similar to that in advanced combat planes.



Prop Aids 'Copter in Flight. The propeller on the outboard stub wing of this new British Fairey Gyrodyne® helicopter is driven by a shaft from the engine that powers the main rotor blade. The wing-tip propeller not only counteracts torque, but helps push the 'copter forward. With a cruising speed of 115-120 m.p.h., the Gyrodyne is designed for economical inter-city flights, air-taxi work, and crop spraying.

Built-in Fire Dept. The fire-fighting system built into the new Boeing Stratocruiser® luxury passenger airliner is shown at right. Three electronic smoke detectors are always alert to flash a warning on the flight deck before flames break out. Carbon-dioxide extinguishing systems, controlled from the pilot's cabin, protect engines, heater, and de-icers. The system was designed by Walter Kidde and Co.

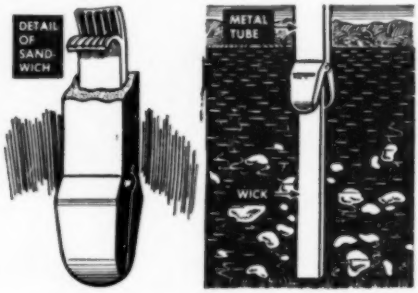


Airport Bog Blotted Dry

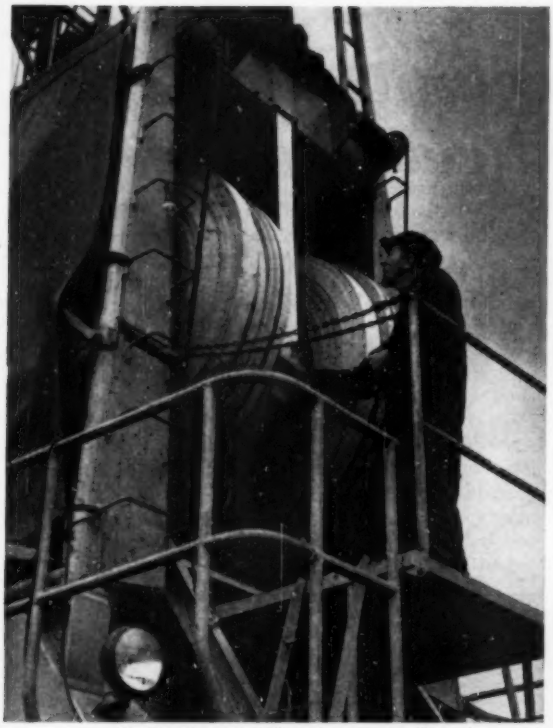
A WAY to build a bone-dry airport on a swamp has been figured out by the Swedish government. The trick is to blot up the water from the subsoil. Wicks of porous paper are pushed into the ground, the water comes up like kerosene in a lamp, and evaporation does the rest.

The system, devised by Walter Kjellman, was first used for an airfield north of Stockholm on the shore of Halmsjon Lake. To get the wicks to bedrock, Kjellman designed a machine to drive a steel tube through the waterlogged soil. The paper goes down with the tube, then the tube is withdrawn.

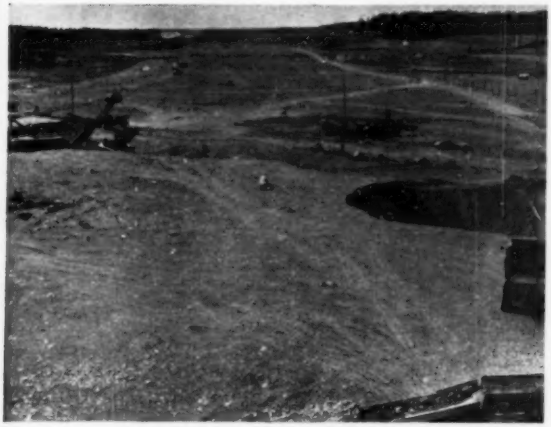
Diesel engine in 65-ft. tower pushes steel tube through soaked soil to bedrock to "plant" long strips of wick for draining airport site. White spots are protruding ends of blotting paper.



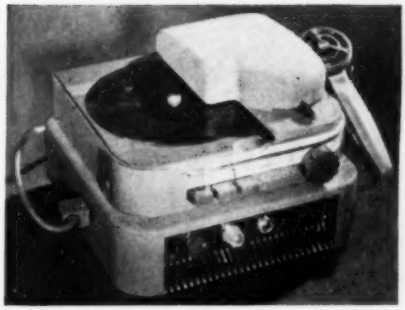
Before: This was the mud puddle that Kjellman faced in effort to create an airport on shore of a lake. He got his idea for draining it from capillary action of oil lamp he used as schoolboy.



Rolls of wick (above) are wound on drums in planting machine. Wick (left) consists of 11 thin cardboard strips sandwiched between mats 4 inches wide. Tube pushed into ground is box-section steel with double-jaw tip. On reaching bedrock, jaws open, tube retracts, wick stays.

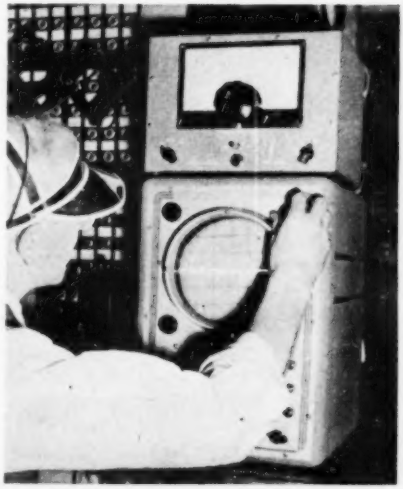


After: Here are two miles of runway ready for concrete surfacing. It is bone-dry only a year after site was cleared of forest. Ordinary drainage methods would have taken 10 years.



Recorder Has No Turntable

A RECORDING machine that has no turntable or ordinary pickup arm and works in any position—even upside down—is now being made for office use. It weighs less than a portable typewriter and records up to half-an-hour on one side of thin plastic records. The disks are turned by a contact roller instead of the usual spinning table. Gray Mfg. Co., Hartford, Conn., makes the Audograph®.



"Radar" Spots Wire Break

A RADARLIKE device is now finding breaks in telephone wires for the Southern Pacific Railroad. It makes use of the fact that wire breaks reflect electric current. The Fault Finder® (on top of oscilloscope) sends an electrical impulse down the wire line, and times the echo caused by a break. The echo time gives the distance, as in real radar.

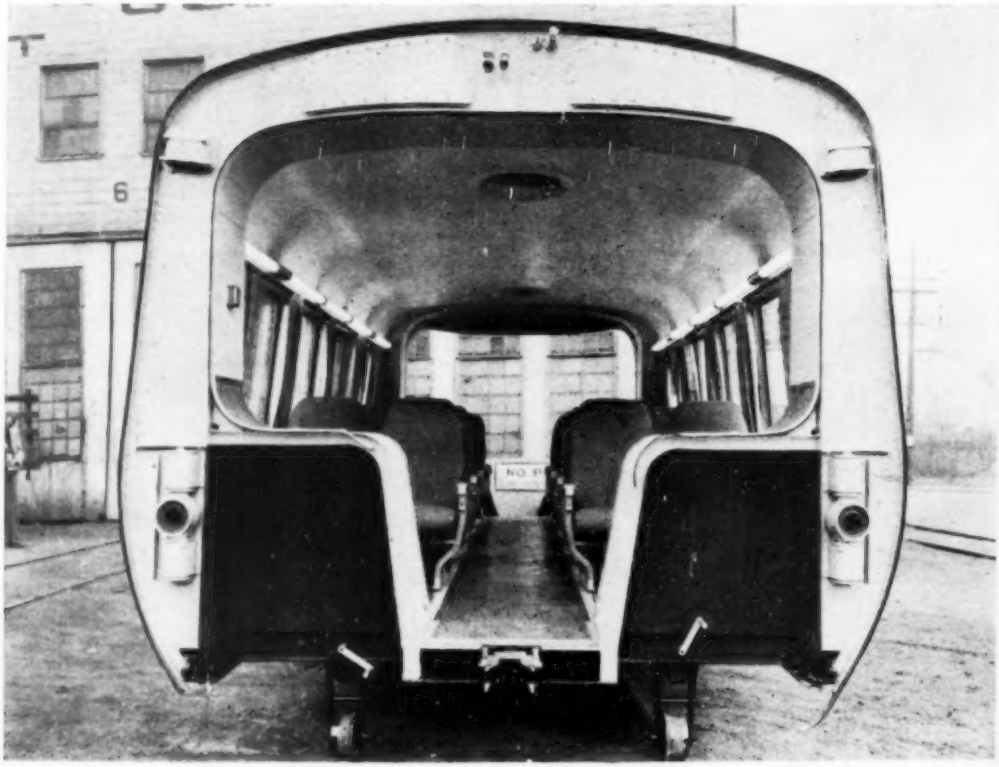
Low-Slung Streamliner Has Two-Wheel Coaches

THE "mystery train" that has puzzled Pennsylvania residents for months has finally been unveiled—literally. American Car and Foundry took off the canvas covers that had hidden the new ACF-Talgo® on its test runs and gave press and public a peek at one of the strangest trains they had ever seen—a slope-backed locomotive pulling low-slung, two-wheeled coaches.

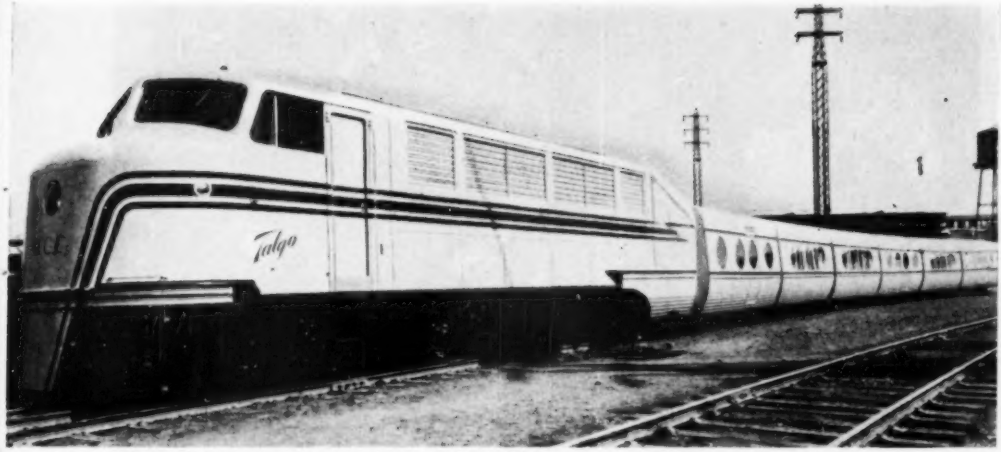
ACF-Talgo's passenger cars are a new departure in design. Built of aluminum, they are four feet lower—the floor is one step off the ground—only about 20 feet long, and seat 16 passengers. Three such cars, an observation car, a baggage car, and a car that contains mechanical equipment are coupled and zippered together to make a single, snake-like assembly. The passenger cars have no outside doors; passengers get on and off through the equipment car.

Each car has only two wheels, at the rear. The front end hooks on the back of the next unit, like a semi-trailer on a truck. This helps the train hug the rails on curves.

The lightweight, low-slung, articulated train promises high-speed, safe travel at very low cost. Built under the Spanish Talgo patents, this one will tour the U. S. Two others are being made for commercial use on the Madrid-Paris run in Spain.



Front end of uncoupled car rests on dolly wheels, lowered by pair of cranks (above). When coupled, front end is supported by sockets (at sides) that slide over pins on car ahead.



Radical Talgo® train can be pulled at high speed by Diesel-electric locomotive weighing only 69 tons, thanks to 1,800-r.p.m., truck-type engines. Rest of train consists of baggage car, three passenger cars, observation car, and equipment car. Low center of gravity is attained by putting all mechanical equipment, usually mounted under coaches, in its special car.

Rear view of car shows pins to support car behind it, coil-type springs, and outer strip that is zipped closed to finish joining cars. Floor is so low that passengers walk between wheels.

Mouse is milked, above, with aid of a miniature electric suction pump. Each mouse yields one cubic centimeter of milk, or about 15 drops. Cost of the mouse milk is $10,000 a quart.

Mouse-cancer virus is caught by camera through electron microscope, magnified 25,000 diameters. Small white dots are virus; two large ones—.0000001-in. latex particles—show size.

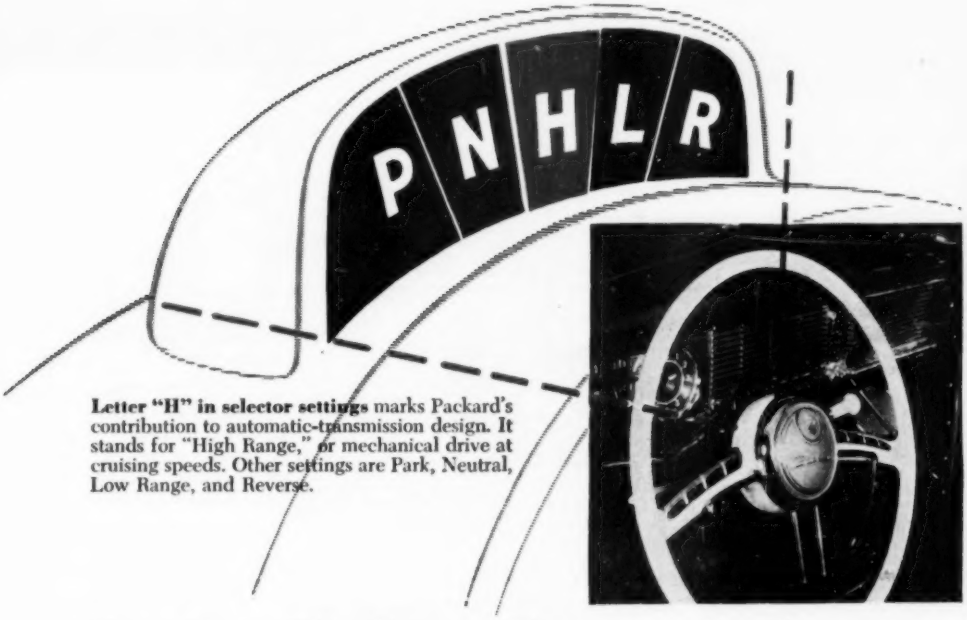
Mice Yield Cancer Virus

HAILED as a long-sought "break" in the battle against cancer, discovery of a virus that causes breast cancer in mice has just been announced by the Columbia-Presbyterian Medical Center in New York City. Isolated from the milk of mice, the virus has been seen under the electron microscope.

Breast cancer of mice closely resembles human breast cancer, the most common form of the disease. It has been studied with the aid of a unique "mouse dairy" at the medical center, where more than 10,000 mice have been milked regularly in the 12-year research leading to the virus discovery.

Finding that cancer could be transmitted from female mice to their offspring, experimenters traced its causative agent to a mysterious "factor" in the mother's milk, the virus now identified. Injecting an almost infinitesimal amount of the virus gives healthy mice cancer. They are most susceptible to infection at a very early age, two weeks or less, though the cancer does not develop until late in their life span. Applying these findings to the human disease must be done with caution, since it is not even known whether there is a corresponding human "milk factor," but they will be of immense help in advancing the research.

Simultaneously, discovery of a "simple, cheap, and reasonably sure" test for human cancer has been announced by Dr. Charles B. Huggins of the University of Chicago. The procedure involves boiling a sample of blood serum. Serum from healthy subjects coagulates; serum from those with cancer does not. Disturbances produced by cancer in the albumen of the blood are responsible.



Letter "H" in selector settings marks Packard's contribution to automatic-transmission design. It stands for "High Range," or mechanical drive at cruising speeds. Other settings are Park, Neutral, Low Range, and Reverse.

Packard's New Transmission Pairs Hydraulic and Direct Drive

With a fancy new transmission that "locks up" to prevent slip, Packard enters the torque-converter battle.

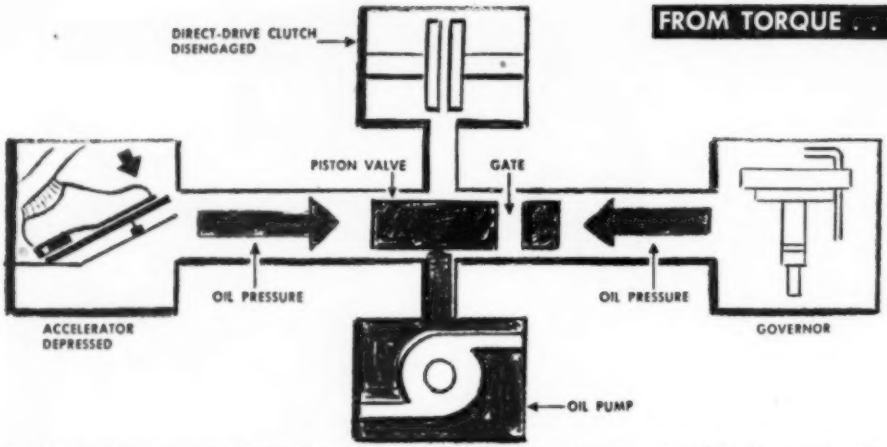
By Devon Francis

FOR many years U. S. auto makers have been hunting for ways to get rid of the gearshift lever. Between 1939 and 1948 three major automatic or semi-automatic transmissions appeared. Two supply step acceleration, and one of them curve acceleration. While all have merit, none is perfect.

Now the Packard Motor Car Company has put out a hybrid transmission that possesses advantages of curve acceleration without some of the drawbacks. To do this, it uses a torque converter for smooth, no-shift acceleration, a gearbox for reverse and low, and direct, mechanical drive for highway cruising. Packard adds a control system that, though automatic, still gives the driver a voice in what happens under the floorboard. It labels the result, with a touch of justifiable pride, "Ultramatic Drive®." The result handles like a dream.

Why the gears? Why not just a torque converter?

A car has to perform different, almost contradictory jobs. It must have tremendous torque—push—at the rear wheels when starting up heavily loaded on a steep hill. Yet it must be capable of top cruising speeds without racking the engine to pieces. And it must back up, if it's going to get out of the garage. No simple, single torque converter is going to do each of these three jobs efficiently. So Packard, like Buick in its Dynaflow®, uses a compact planetary transmission to help out. This gives a low ratio for plenty of hill-starting push, and a low reverse ratio for backing.



1 Heart of Ultramatic Drive® is this semi-automatic method of switching from torque converter to direct drive and back. Schematic diagram above shows how it's done. On starts, hydraulic pressure controlled by accelerator pedal overcomes the lesser pressure delivered through governor. Valve stays shut and torque converter drives car. Clutch is disengaged.

Why direct drive? Why have at times a solid mechanical connection between engine and wheels?

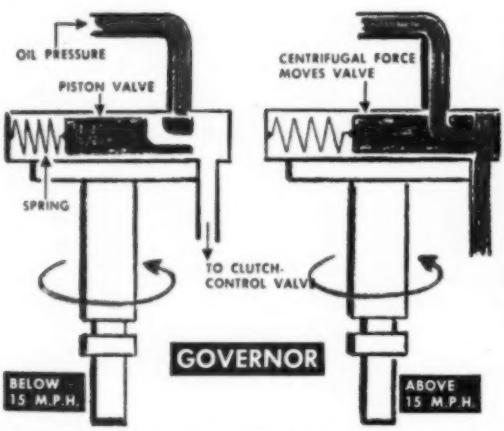
Here are Packard's answers:

1. It's more economical. Hydraulic couplings are afflicted with slippage that reduces gas mileage. Packard asserts that the fuel mileage from its new transmission is even a shade better than that obtained from a manually operated gearbox.

2. It's simpler. There are fewer parts to a converter-plus-direct-drive transmission than to other comparable ones.

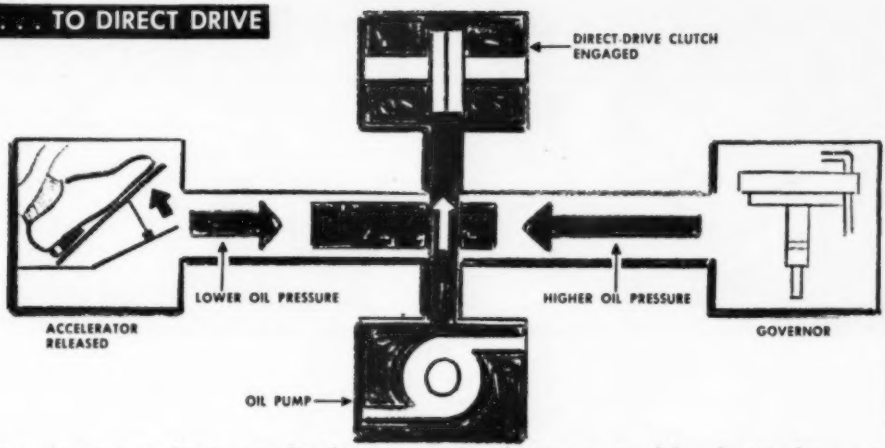
3. It gives the driver a more positive and flexible control. It doesn't give you the feeling that the engine is racing when you accelerate after coasting for a bit. It gives extra acceleration fast when you pull out to pass. And it gives full use of engine-compression braking when you're going downhill.

I can testify to the new transmission's performance. The transition from torque



Key part of the control system is the governor, shown in diagrams and photo above. Its job is to hold down oil flow on clutch-control line until car reaches 15 m.p.h., and then to pass oil in proportion to speed and pressure. Spring-held piston in whirling rotor moves over to open port as speed increases. The photo above shows head of the intricate governor and shaft that turns it.

. . . TO DIRECT DRIVE



2 As car goes faster, your foot lets up on accelerator pedal and pressure it controls drops. But governor, which turns at road speed, not engine speed, passes far greater pressure. So valve piston moves left and main oil pressure flows through to force engagement of direct-drive clutch. Torque converter, its work temporarily done, is cut out of the power train.

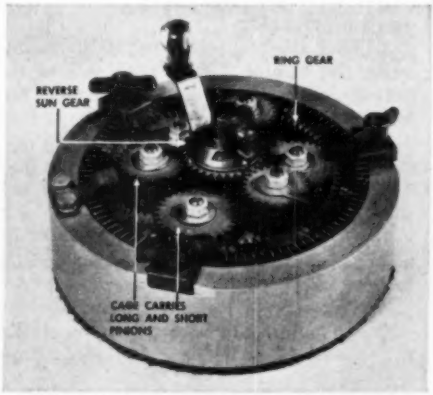
converter to direct drive and back again is silk-smooth. To go from converter to direct drive, once the converter has you rolling, you need only let up the accelerator for an instant, just as in a car equipped with overdrive. And also as with overdrive, if you need a sudden burst of acceleration, just push the pedal to the floor. Back you go to torque-converter drive.

If you're stuck in snow or mud and want to "rock" the car out, just flip the steering-column selector lever back and forth between reverse and low. If you want to shoot away from a stoplight like crazy, just tromp the pedal down and hold it there. The converter will take you up to 56 m.p.h. in a hurry, and then direct drive will take over automatically.

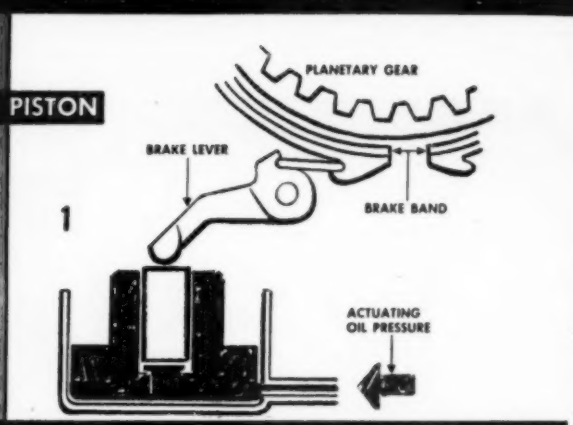
Crossing hydraulic with gear drive and whelping a compact transmission that's instantly responsive to the accelerator was no mean achievement. It took a long time. Packard has had something like this in mind for 16 years.

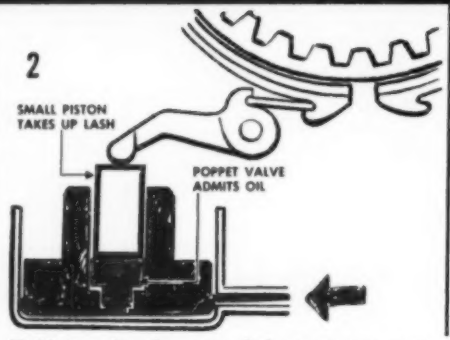
The new transmission is a layman's nightmare of hydraulic lines, pumps, valves, gear brakes, and clutches. But driving with it is simplicity itself. For all ordinary driving you put the selector lever in high and forget it. You use low only for extra hard pulls or superfast getaways. Flip it over to reverse to back up. And when you leave the car, move it over to P (park). This locks the drive-shaft mechanically. Incidentally, you can't start the engine with the transmission in gear; an electrical interlock cuts out the starter except when the lever is in Park or Neutral.

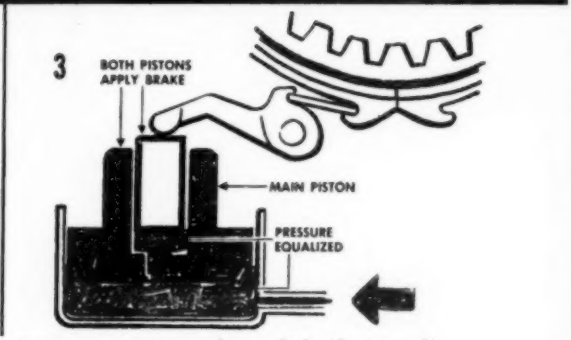
In all three operating settings—L, H, and R—the torque converter is part of the power train between engine and wheels at speeds under 15 m.p.h. It increases the twist imparted to the propeller shaft. In positions L and R, the gearbox also imparts its mechanical advantage and, in position R, rotation change. In position H, the gears



Model of the planetary transmission was built by Packard engineers to show low-gear and reverse actions. It has two sun gears; one shown is for reverse, and forward one is under it.







Held in a hand is one of the ingenious compound pistons that tighten brake bands on the planetary transmission used for low and reverse. The purpose of inner piston, as shown in drawing sequence, is to take up lash (free travel) in linkage, and to avoid abrupt brake application. The valve inside closes when pressures under big and small piston are equalized.

are, in effect, locked out to provide a 1-to-1 ratio between converter and shaft.

The result of this, so far, isn't unlike Buick's Dynaflow® transmission (PS, Feb. '48, p. 113). But right here Packard introduces its gimmick:

A clutch directly connected to the engine seizes the turbine (or output) side of the torque converter at certain speeds. The turbine is solidly connected to the gearbox shaft. The engine and rear wheels are now mechanically linked, with a ratio dictated by the gear transmission. Torque multiplication through the converter ceases. The pump inside the converter, which has been multiplying torque with oil bucketed against the turbine and reactor blades, is now bypassed and out of the power train.

But something has to work that clutch that gloms onto the turbine at just the right moment. That's where Ultramatic Drive begins developing a brain. It employs a speed-sensitive governor that meters oil flow on special control lines.

The governor whirls around on power picked off the speedometer drive on the propeller shaft. Hence it responds purely to road speed, not engine r.p.m. Up to 15 m.p.h., it doesn't spin fast enough to open an internal governor port that, in turn, opens a valve to actuate the clutch. Above 15 m.p.h. it does, *except when.*

And here's the final major element in Ultramatic: the governor goes into action above 15 m.p.h. *except when* an opposing hydraulic pressure in the clutch-shift valve is greater than the governor can supply. This opposing hydraulic pressure comes from your toe on the accelerator and gives you a choice between the two drives at any speed between 15 and 56 m.p.h. The pedal is linked to a servo-booster mechanism that dishes up pressure in direct ratio to the amount the pedal is pressed.

That's why the car goes into direct or gear drive when the pedal is released momentarily: the governor-metered pressure overcomes pedal-metered pressure. The accelerator, if pressed to the floor, can "overpower" the governor up to 56 m.p.h. Above that

	HIGH-RANGE CLUTCH	LOW-RANGE BRAKE	REVERSE BRAKE	TORQUE CON-VERTER	GOV-ERNOR	DIRECT-DRIVE CLUTCH	PROPELLER SHAFT
PARK	Not working	Not working	Not working	Not working	Not working	Not working	Pawl engaged
NEUTRAL	Released	Released	Released	Idling	Not working	Released	Not working
HIGH	Engaged	Released	Released	Accelerates car from start up to 56 m.p.h. Can be locked out above 15 m.p.h.	Engages direct-drive clutch when accelerator pressure is overcome	Cuts in at driver's will anywhere between 15 and 56 m.p.h.	Accepts power from either torque converter or direct-drive clutch
LOW	Released	Engaged	Released	Delivers power to rear wheels through low-range gears	Same as in high range	Cuts in at driver's will anywhere between 15 and 56 m.p.h.	Same as high range but power passes through low-range gears
REVERSE	Released	Released	Engaged	Delivers power to rear wheels through gears	Not working	Released	Same as high range but power passes through reverse gears

This table lists function of major transmission components in each control-lever setting.

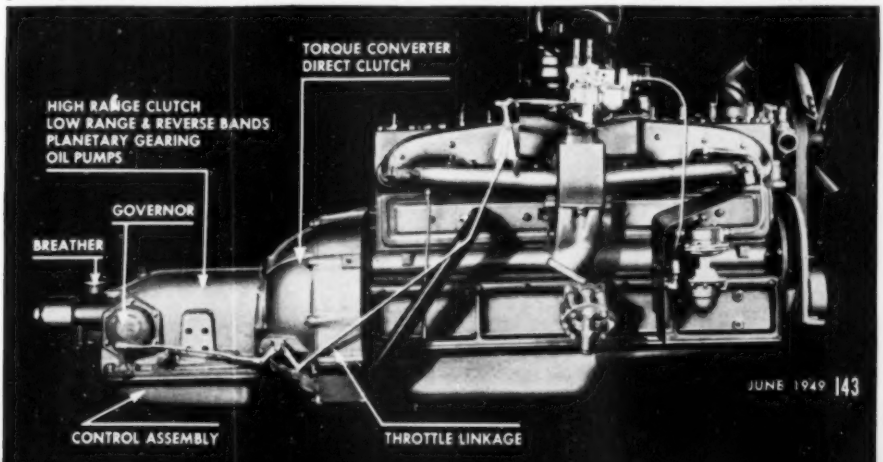
the governor passes too much pressure to be kept from operating the clutch valve.

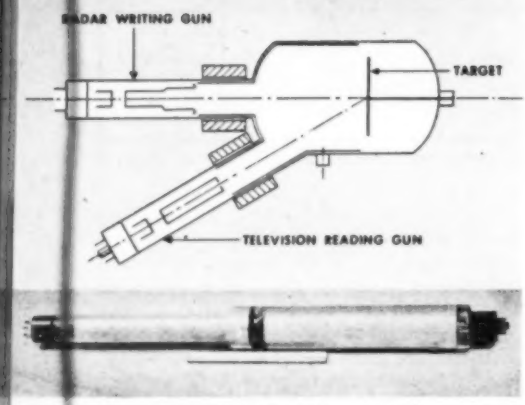
The planetary gearbox is triggered by a pair of ring-gear brake bands. One stops the forward sun gear for low, and the other the ring gear for reverse. The designers uncorked a slick trick with these gear brakes. They had to guard against brake drag. That called for ample clearance between band and drum. Clearance meant taking up lash when the brake was contracted. Smooth but fast operation, with a minimum displacement of the control fluid, was also important. How they managed to do it, using an ingenious double-piston principle, is shown here in the accompanying drawings.

Packard expects to use its new transmission in a bid to regain the commanding position it once held in the fine-car field. The atmosphere around its Detroit plant is charged with the conviction that it can give all other transmissions aces and deuces and still pace the field.

Ultramatic is the baby of J. G. Vincent, Packard's engineering vice president, the man who designed the first U. S. 12-cylinder car, and Forest McFarland, who is chief research engineer of the company. At first Ultramatic will be standard only on the Golden Anniversary Custom Eights®. Later it will be offered as optional equipment on other cars in the company line. END

Complete transmission makes a clean, compact package. The direct-drive clutch runs immersed in oil. The engine develops 160 hp., and delivers power through Hotchkiss-type drive.





Experimental model of Graphecon®, combined radar-television tube, is held by inventor Louis Pensak (top). Sketch shows design. Production model (bottom) has guns facing on straight line.

TV and Radar Teamed in Tube

A NEW kind of cathode-ray tube that combines radar and television will soon be used in Teleran®, the blind-flying system. One end of the new tube serves as a radar receiver, while the other end does the work of a television camera.

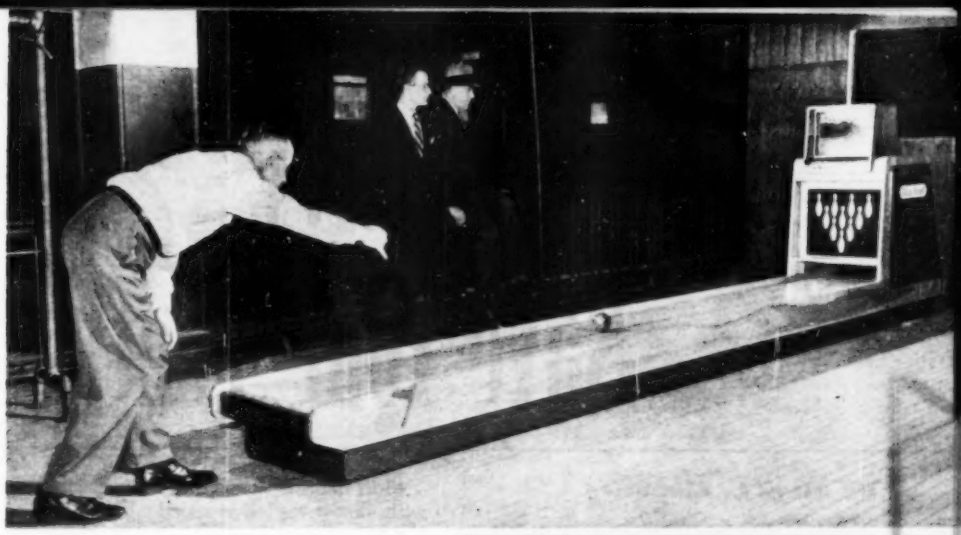
In Teleran, the radar picture, superimposed over a ground map and containing other information, is sent back to a television screen in the pilot's cockpit. The pilot can see himself flying as though he were watching from the ground. In the previous Teleran setup, a standard television camera was simply pointed at a standard radar screen. The new tube greatly simplifies the system and improves its operation. It eliminates the necessity of creating a visual image from radar at the ground station and then changing it back into television waves.

The new tube, called a Graphecon®, has two electron guns, both aimed at a single target—a 3-in. square of metal coated with a layer of quartz only 20 millionths of an inch thick. The radar gun traces its picture on the target, changing the voltage of the target surface everywhere its beam strikes. The target serves as a storage unit, holding the radar signals until they are picked up by the television gun. The TV gun reads the radar picture by scanning the target continuously and sending out a signal whenever it strikes an area whose voltage has changed.

The Graphecon was developed by Louis Pensak, of RCA Laboratories, Princeton, N. J.

Skeleton Rig Televises Race

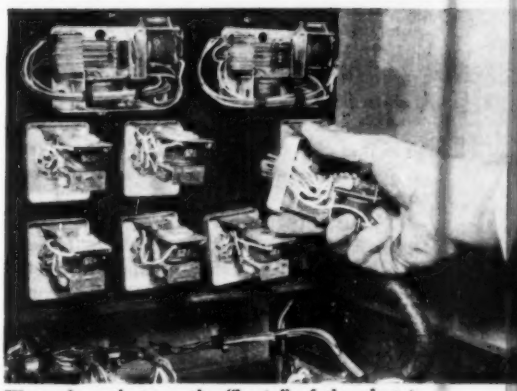
BRITISH televisers provided a striking contrast to American TV techniques when they covered the Oxford-Cambridge crew race on the River Thames with only one camera and four "suitcase" units. All equipment (shown in photos below) rode in one small launch. For "remote pick-ups" here, U. S. TV crews usually take a truckload of apparatus.



Midget Alley Uses Electric Pin Boy

PS photos by Hubert Luckett

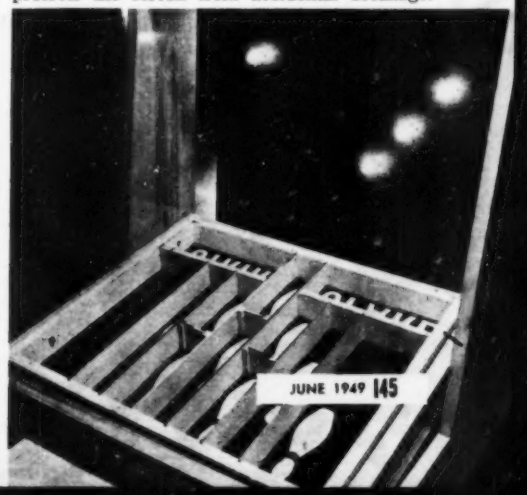
THIS scaled-down bowling alley taxes your skill without straining your muscles. It is about one third the size of a standard alley and uses a ball slightly smaller than a duckpin ball. The "pins" are illuminated images on a vertical screen. Below the screen, switches are arranged in the familiar pattern of a regulation tenpin setup. When the ball rolls into paddles sticking down from these switches, pin images blank out to represent "hits." Tests show that a skilled bowler makes within ten percent of his big-alley scores.



The relays that are the "brain" of the electric pin boy are all designed to plug in like a radio tube. This permits easy servicing of machine, made by Electric Boat Co., Bayonne, N. J.

Here the ball is rolling into the switch paddles. Hit, these lift up to operate the switches that blank out the pin images. Score is added automatically when ball drops into return trough.

Vertical screen with pin images is swung down to show arrangement of lights and partitioning to close off each "pin." A heavy plastic sheet protects the screen from accidental breakage.



Can Chemistry Save Your Teeth?

By Alton L. Blakeslee

THE enamel of your teeth is about as hard as the steel in the blade of your pocketknife. It's fine for gnawing chicken bones or a tough steak. Yet that hard enamel gives way, in 95 percent of us, in the quick, aftermeal "explosions" of tooth decay. Now there's hope that this can be stopped—that we can be spared the dentist's drill, partly or even completely.

For years tooth decay has stumped the experts. A conservative estimate is that there are 430,000,000 cavities in American teeth. Our dental bill runs $750,000,000 a year, not counting another $105,000,000 for toothbrushes and pastes. We kept getting decay even when we followed the dentists' advice.

But now dental researchers are eagerly testing four new ways of stopping some or all of our tooth decay. One is to doctor drinking water with fluorine. Another is to give teeth a chemical "booster" brushing after meals. The third is to put chemical road blocks in the tooth enamel. The fourth is to add something to our food.

Most dentists now agree that decay starts with almost explosive speed right after you eat. It isn't something that goes on night and day at a constant rate, like a tireless termite. Instead, decay may start three to five minutes after you eat foods containing refined sugars or carbohydrates. It can keep on going if food lodges between the teeth or films or plaques form on the teeth.

Decay is thought to come primarily from the action of acids. These acids are formed by bacteria working on refined, fermentable sugars and carbohydrates. Main troublemakers among the bacteria are the *Lactobacilli acidophilus*—the kind that make milk turn sour.

Fluorine as an anti-decay agent looks good. It appears to help by making the tooth enamel stronger, or by reducing the number of bacteria. It's credited with cutting down decay in children from 40 to as high as 70 percent.

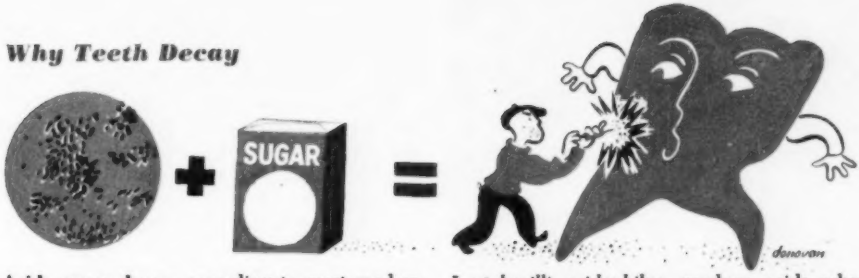
The idea to use it came from studies of people with strange, ugly discolorations or mottling on their teeth. The mottling was brownish or chalky-white spots on the

What Dentists Are Doing about Decay

Drinking fluorine in water helps rout Danny (the Driller) Decay, but dental detectives are not sure yet whether it is by strengthening teeth against acids or by cutting down the bacteria.

New tooth powders, containing ammonium nitrogen or ammonia ions, are also giving Danny Decay a hard time. The ions help fight harmful bacteria and neutralize acids at the same time.

Why Teeth Decay



Acids cause decay, according to most modern theories, eating away outer, protective enamel and starting cavity that works quickly into softer, central part of tooth. Common bacteria, chiefly *Lactobacilli acidophilus,* produce acids when they work on refined sugar and carbohydrates. Decay begins "explosively," it is believed, almost immediately after food is eaten.

enamel. It occurred in people who lived in certain towns.

Dental detectives hunted down the trouble. The drinking water in these towns contained small amounts of fluorine. The detectives got excited when they saw something else. Many of these people with mottled teeth had no decay at all. The others had much less decay than people who didn't get fluorinated water.

Controlled Tests Begun

The experts found that only a tiny bit of fluorine, one part per million of water, wouldn't cause mottling, but might still cut down on decay. Children in three New Jersey towns get water from wells containing this amount of fluorine. They showed 70 percent less decay than children in two other towns where there was no fluorine in the water.

A stricter test, over five- to ten-year periods, is under way in half a dozen cities and towns. Results in these towns will be checked against comparable towns where fluorine isn't added.

There's a shortcut in the fluorine treatment that apparently also works. This is to put a two-percent solution of sodium fluoride on the teeth after they have been carefully cleaned and dried. The fluoride treatment is given four to six times, by a dentist, within a period of a few weeks. So far, reports show about a 40-percent reduction due to the fluorine.

There's a rub, however. The fluorine, either in water or directly applied, seems to help only children, not adults.

The second weapon against decay is brand-new tooth powders that help adults as well as children. One formula, developed in New York, is credited with bringing a 35-percent reduction in decay. It worked in four out of five people.

These powders are really a double-barrel shotgun charge. Both barrels supply ammonium nitrogen or ammonia ions to fight the harmful bacteria. The ions prevent the growth of the bacteria, and also neutralize the acids as they are formed. One charge of the shotgun is dibasic ammonium phosphate, for a quick after-meal supply of the ions. The other charge is synthetic urea, for a long-

A different theory says Danny Decay is really bacteria, not acids, that enter teeth through tiny channels in enamel. To stop decay, teeth are treated with chemicals that plug up channels.

ENAMEL-PORE PLUGS

Destructive Danny wouldn't stand a chance, say some experts, if a chemical were found that could be added to refined foods, such as sugar, to slow down their fast formation of decay acids.

CHEMICALS IN FOOD

Bacteria colonies in lower dish above have been wiped out by Amm-i-dent®, one of the new tooth powders. Tiny spots in upper dish show that untreated bacteria continue to flourish.

lasting, slow release of the ions to keep up the job.

These powders give a chemical boost to a natural defense against decay. This normal defense is urea, which is found in everyone's saliva. Back in 1934, two dental researchers studied some of the lucky people who don't get tooth decay. They found these people had high concentrations of salivary urea. There was much less urea in the saliva of people who did get decay.

Then Dr. Robert M. Stephan of the U. S. Public Health Service discovered that teenagers using a solution containing synthetic urea got a lot less decay, apparently up to 95 percent less.

Two research teams, in Chicago and New York, went to work independently. They're now testing dentifrices containing the dibasic ammonium phosphate and urea, using different proportions. One team is headed by Dr. Robert G. Kesel of the University of Illinois. The other is led by Dr. Chester J. Henschel, research director of the Eastern Graduate Research Foundation. Both are trying the new powders on children to learn how effective the chemicals really are.

An entirely different theory of tooth decay is rocking the dental applecart. It comes from Dr. Bernhard Gottlieb of Baylor University's College of Dentistry, who reports 90 percent success in reducing tooth decay.

Instead of acids dissolving enamel, it's bacteria that cause dental decay, says Dr. Gottlieb. He believes the bacteria invade the enamel, entering along tiny channels of organic material running threadlike through the enamel. The bacteria work down through this living matter and attack the less-calcified dentine under the enamel. There they do an undermining job. Acids also can be formed there that may eat up into the enamel.

Gottlieb's answer is to block the threadlike channels, called lamellae. He puts chemical road blocks at the entrances of the channels. The chemicals penetrate down through the channels, and thus also block any sensitivity to cold or sweets. These chemicals are 40 percent zinc chloride and 20 percent potassium ferrocyanide. This compound produces a white salt, which won't dissolve, that plugs the invasion roads. The American Dental Association says, however, that it's too early to tell whether Gottlieb is right.

Meanwhile, other experts are seeking an answer that wouldn't even involve a visit to the dentist. Their theory is based on the belief that fermentable foods nurture bacteria and produce acids that start the decay. They have interesting evidence to support their theory.

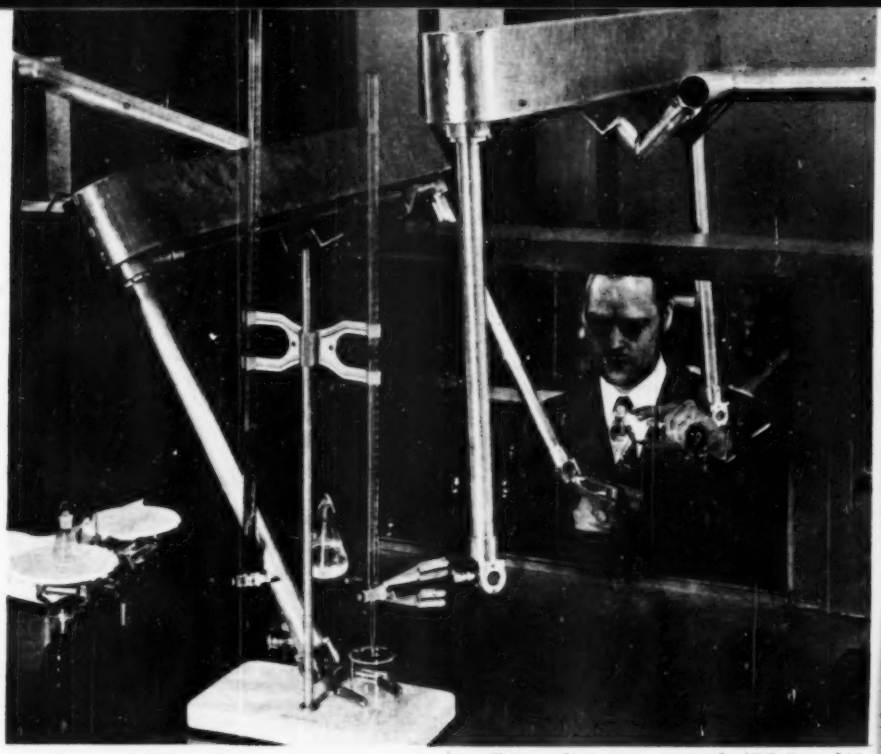
In occupied countries and in concentration camps during the war, many people had poor diets. They didn't get refined sugars or other refined foods. Many lost weight, got terrible diseases, including gum troubles, or died of starvation. But the odd fact was that they had little or no tooth decay.

Refined Foods Produce Decay

Some islanders who don't eat our "civilized" foods don't know what decay is. And if humans don't eat sugars or refined carbohydrates, the decay-producing bacteria in their mouths literally starve. These people might or might not get as much decay—it's too tough to keep them on such a diet.

All this seems to incriminate the refined sugars and carbohydrates. There's a suspicion that the refining removes something that makes them more likely to break down and form decay acids. The answer now sought is a chemical, to be added to sugars or starches after they have been refined, that will counteract or slow down the fermentation action. This could be done easily by wholesalers. The chemical would have to be tasteless, odorless, colorless, and nontoxic. Some chemicals have looked good in test tubes, but none has yet passed animal tests. This would be an excellent way to halt decay because everyone would get the protection without even thinking about it.

The final score hasn't been posted yet on any of these new methods. Maybe when the returns are in we'll start using one, two, or all, and ward off that toothache. END



Robot Handles "Hot" Material

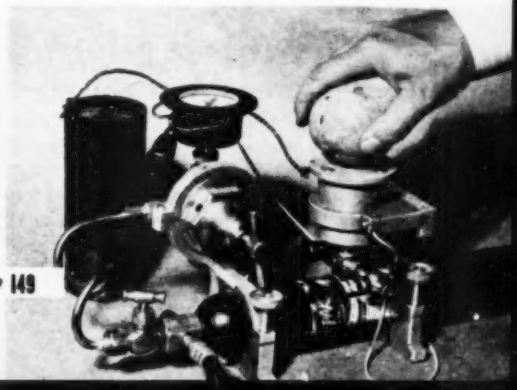
THESE mechanical hands can imitate every human motion in grasping, lifting, moving, and turning small objects. The latest thing in protective equipment for laboratory workers handling radioactive materials (PS, June '48, p. 91), they duplicate the actions of an operator working from a safe distance behind a radiation shield. The robot, called the "master-slave" manipulator, was developed at the Argonne National Laboratory in Chicago.

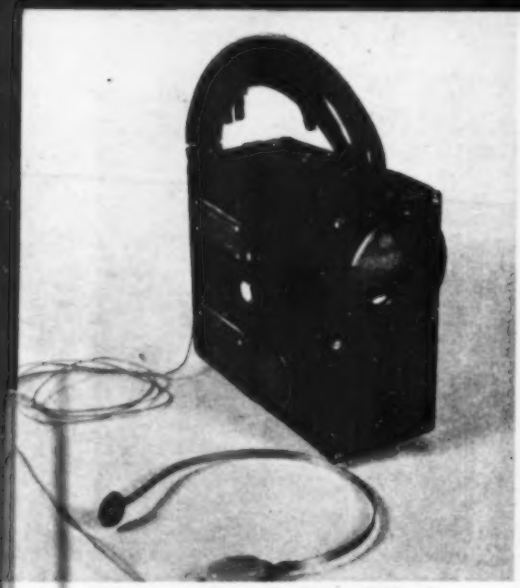
Chimney Built in Sections

WHAT looks like a piece of glass sponge cake (below) is actually a sample slice of prefabricated chimney. The brickless chimney is built to any height in 24-inch sections of insulated ceramic covered with aluminum. It can be installed on basement furnaces or as a flue for stoves and utility-room heaters, says its manufacturer, the Van-Packer Corp. The flue opening is 7 inches in diameter; the insulation is 3 inches thick.

Fruit Tester Shows Ripeness

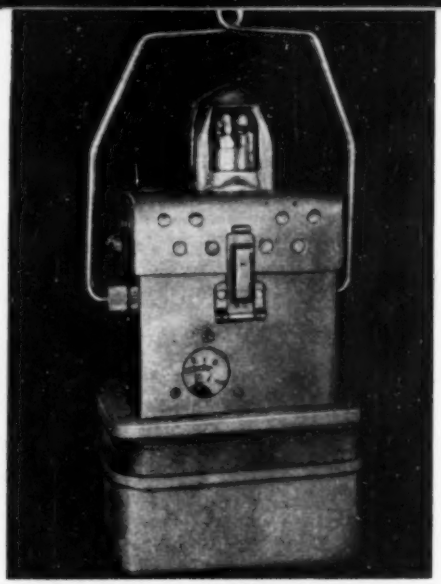
HERE'S a machine (below) designed to test the ripeness of fruit without bruising it or breaking the skin. Invented by Dr. Edward Ross, of State College of Washington, it has a small piston that pushes a blunt brass tip 1/32 inch into the skin. The force needed to do this is read directly from a scale, indicating how hard the fruit is and thus how ripe it is. The piston is powered by compressed gas in a cylinder.





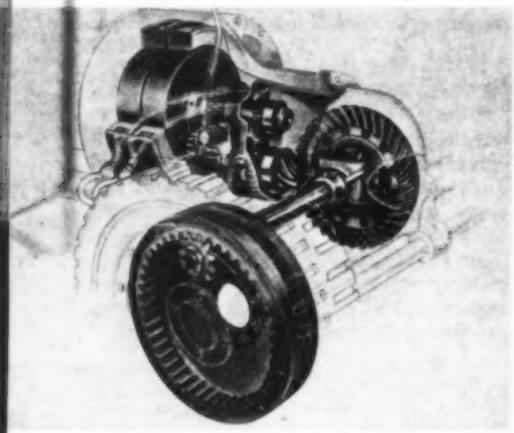
Electric Eye Guides Blind

An electric "Seeing Eye" that warns a blind man of obstacles ahead is now under test. The Signal Corps device projects a light beam 15 feet ahead. Any obstruction reflects the beam back to a photocell, which starts either an audible buzz or a vibration in the handle, the speed of the signal increasing as the distance to the object decreases. It's no good against fast moving objects, however.



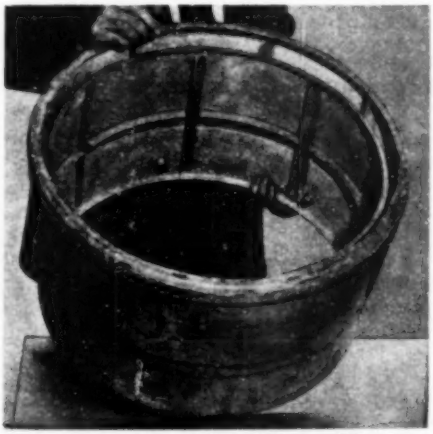
Light Warns of Blast Danger

Workers in air contaminated with natural gas or oil vapors won't have to worry about explosions if they carry the Explosilite®. It shows a flashing red light when explosive gases reach a dangerous concentration. Made by Mine Safety Appliances Co., of Pittsburgh, the Explosilite is self-powered and has a tamper-proof lock—you can't open it without a special magnet.



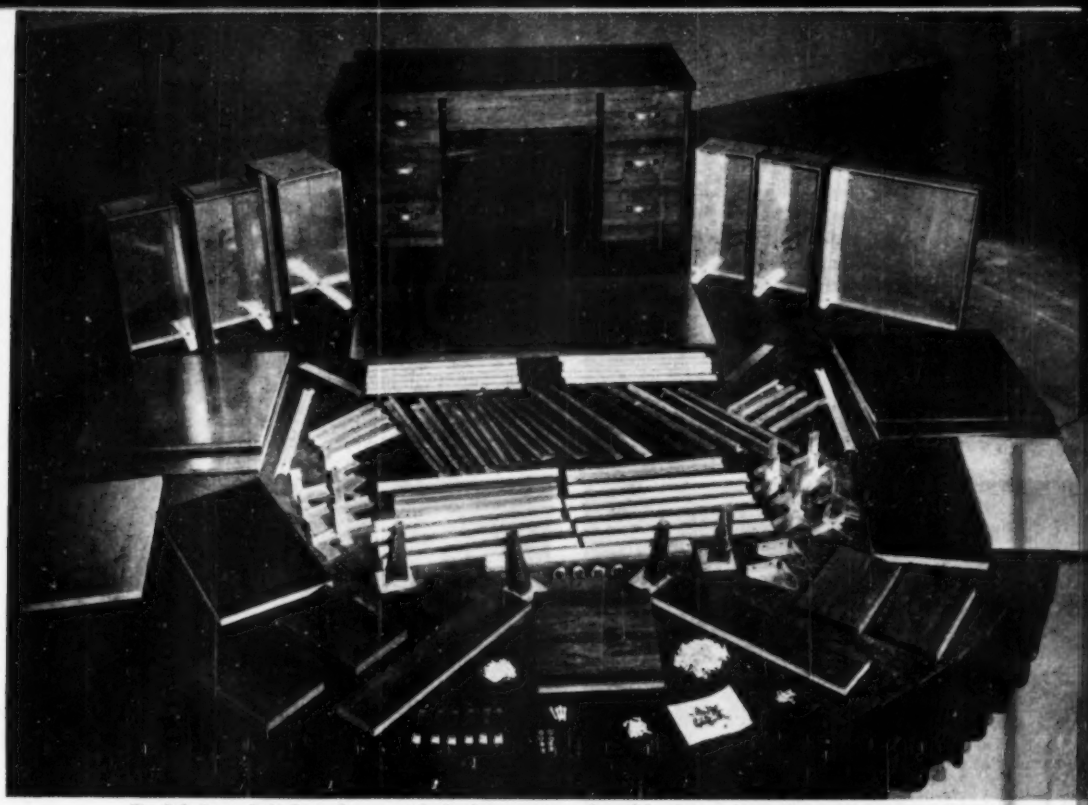
Magnets Reverse Lift Truck

A magnetic drive permits the new Clark industrial lift truck to reverse direction at full speed. The flywheel has two magnetic coils—one forward and one reverse—selected by flipping a switch. The coil's magnetic field drives the rotor geared to the wheels.



Washing Machine Uses Glass

Glass—tough, instead of fragile—is going into some of the trickiest parts of an automatic washing machine. Apex Electrical Mfg. Co. uses plastic reinforced with Fiberglas® for water balance rings, which maintain washer balance while clothes are spun dry.



Prefabricated desk is shown with duplicates of the parts from which it was assembled. This is one item of a new line of furniture built of replaceable plywood panels on precisely machined metal cores. Parts are finished before being put together. Metal in 115-lb. desk weighs 14¾ lb.

New Furniture Built Of Replaceable Parts

WHEN Don Wallance was a civilian employee of the Quartermaster Corps during the war, he often wondered why the Army kept buying furniture for its offices and post homes that had to be refinished after a bit of banging around. Why not furniture with replaceable parts? he asked.

After the war Wallance went to work on that idea. As a professional designer, he created furniture with precision-built parts as readily interchangeable as the parts of an automobile. Today the Army and the Air Force are buying the new furniture by the scores of thousands of units.

Wallance introduced three innovations in furniture making: glueless joints, metal cores to which plywood panels are screwed, and

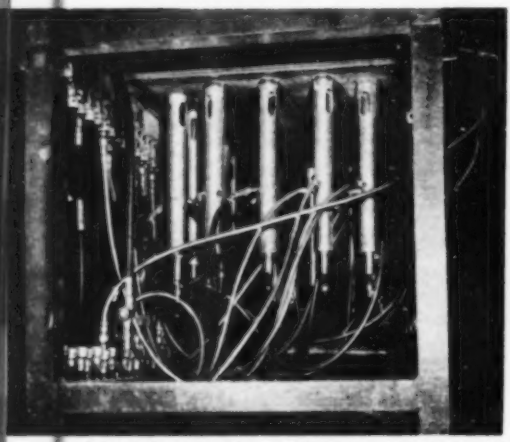
Metal parts for the new furniture are cut and shaped at Cessna Aircraft factory in Wichita, Kans. Machine below forms the sides and back of a drawer in three quick bending operations. Wood panels are made and furniture is assembled at the company's nearby Hutchinson branch.

precisely machined parts. A desk drawer of a given type will fit any one of thousands of desks. If a table top gets damaged, remove a few screws, take it off, put on a new one.

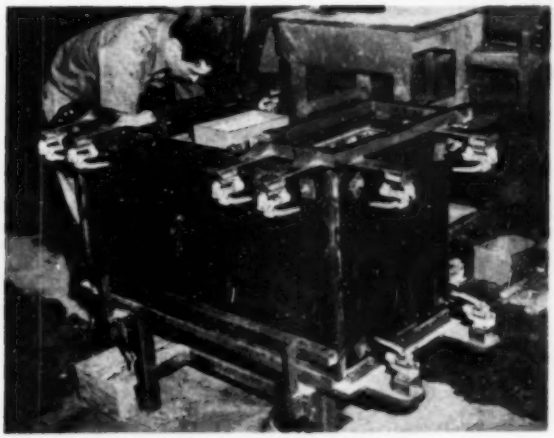
Key to the manufacturing process is the core of framework, made of aluminum alloy .064 in. thick. The plywood itself won't swell, discolor, or check in subzero cold or tropical heat. Its layers are glued with a plastic that resists termites, humidity, and fungus. It can be finished in any veneer desired. The veneers are impervious to alcohol, boiling water, and even nail-polish remover.

Several U. S. firms are now making the furniture. Biggest purveyor to the Army and Air Force is the Cessna Aircraft Co., of Wichita, Kans., where the accompanying pictures were taken. Cessna got into the business because of its experience with aluminum aircraft structures.

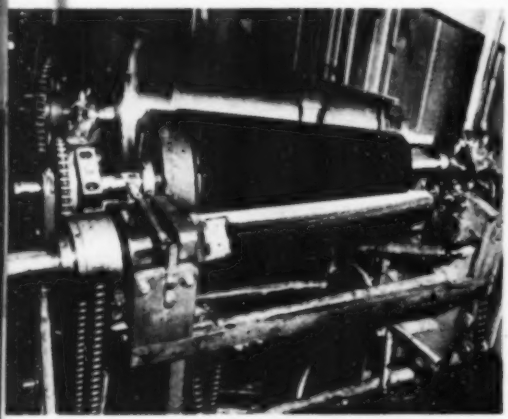
Now the company is turning to commercial manufacture of the furniture. Its chiffoniers, sideboards, dining-room tables, and consoles are handsome enough for any home. But Cessna figures its first customers will be hospitals, hotels, and other establishments where furniture repair is a big item in the annual budget.



Multiple air drill, run by one man, bores 18 screw holes in plywood panel in four seconds.



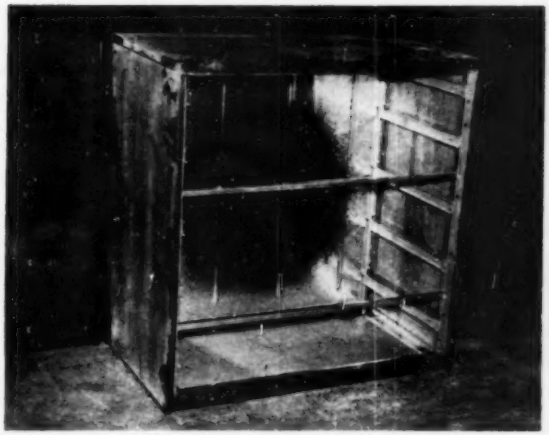
Aircraft-type jig clamps panels to desk frame while worker puts screws in predrilled holes.



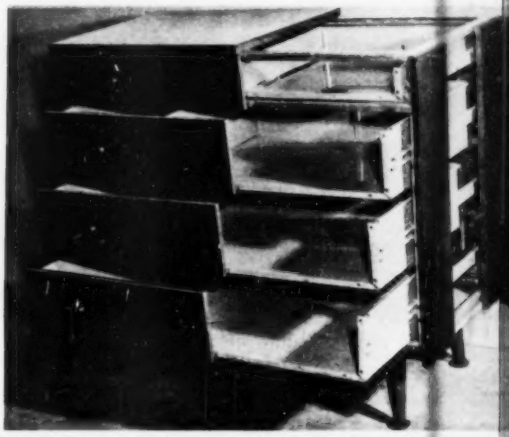
This machine, only one of its kind, was developed by Cessna to print wood-grain pattern on tapered metal legs. Engraved steel cylinder (rear) transfers pattern to rubber roller, which prints on chair leg in foreground. Above, right, finished legs are riveted to stamped-out seat pan. In background is fuselage of Cessna 140® plane under construction in the same plant.

Metal core for desk is drilled and riveted in same way this factory also builds airplanes.

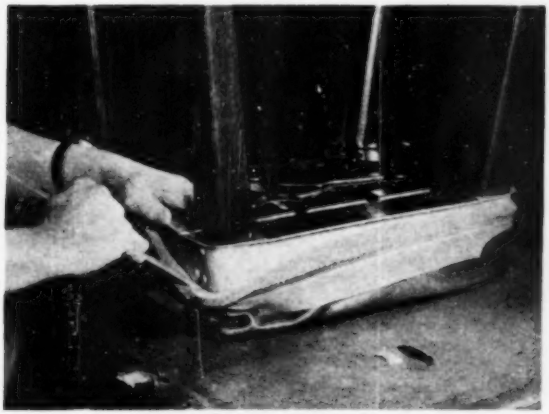
Plywood panel is sanded, seal-coated, filled, stained (above), varnished twice, then rubbed.

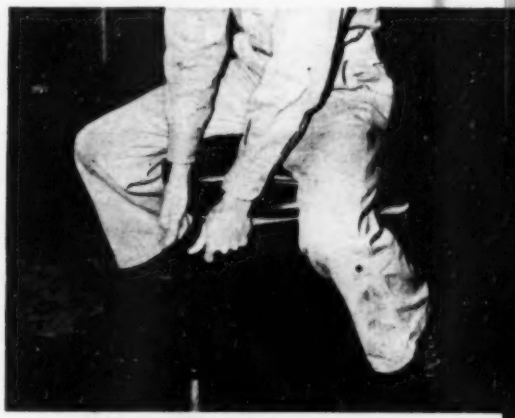


Sound-deadening coating on rear panel of metal chiffonier frame will muffle the noise of the doors.

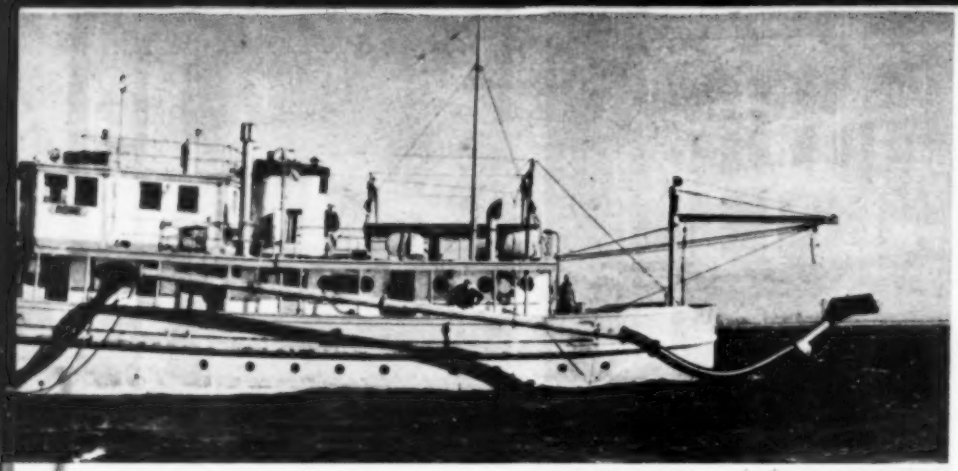


Cutaway model of bureau shows wood panels and aluminum frame to which they're attached.





Chair is cushioned with a pad of foam rubber under an imitation-leather cover stretched over the metal seat pan. Since both are held in place only by tension of the cover, they can easily be removed and replaced. Softest job in factory is that of man who spends all day sitting in one chair after another (above) to press down their seat pads and covers for the final tight fit.



Vacuum Cleaner Picks Oysters

VACUUM cleaners have been used for everything from drying film to painting furniture, and now one is picking oysters from the bottom of the ocean. The oyster picker is a giant among vacuum cleaners—a 6-ft.-wide nozzle (right) at the end of a 10-in. rubber and steel suction hose more than 60 feet long. The nozzle rolls across oyster beds on a rubber-tired dolly, hauling up 2,400 gallons of oysters and water per minute. It also cleans up the boring snails, ocean pests that destroy many oysters. B. F. Goodrich made part of the huge vacuum cleaner for H. C. Rowe & Co., of New Haven, Conn.

New Stone Breaker Smashes Huge Boulders on the Fly

ROCKS bigger than a desk are smashed to gravel smaller than your hand by a new stone crusher that bats them around like the shuttlecock in a badminton game. Biggest of its type ever built, the 54-ton machine has two "impeller" wheels whose heavy blades swat the huge boulders in mid-air, throwing them against one another and also against steel breaker bars surrounding the chamber (see drawing, below right). Each "impeller" weighs more than two tons, yet can be turned by a touch of the fingers. The New Holland Manufacturing Co., of Mountville, Pa., makes this Model 5050 breaker.

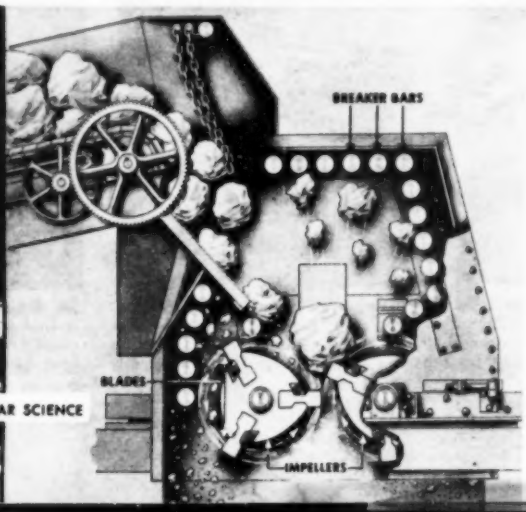


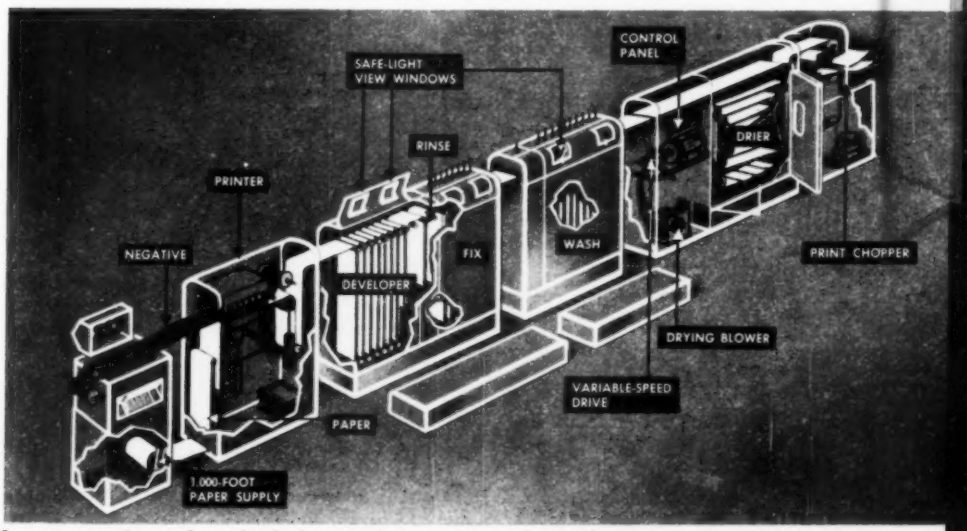
Photo Lab Flies to Front

THIS "flying darkroom" can turn out 20,000 photo prints a day. A complete photographic processor, it is designed to fit inside the detachable fuselage of the Fairchild C-120, latest version of the Flying Boxcar®. Developed by the Air Materiel Command, the photo-multiprocessor will make photographic intelligence immediately available in front-line military areas.

By changing solutions in the tanks and making minor adjustments, the multiprocessor can be used either for processing aerial strip film or for printing finished pictures. It can handle 600 feet of black-and-white negatives an hour. With additional tanks, color work can be processed.

In the printing phase, developed negatives are fed into one end of the machine. After the paper has been exposed under a battery of lights, it moves forward automatically through various chemical and wash tanks. Finished, cut prints, either 9 by 9 in. or 9 by 18 in., come out the other end. The machine is built in detachable sections for easy assembly and dismantling. END

With a twist of the wrist, man in foreground starts film and paper on their way. Negatives are moved manually, but the paper progresses automatically through chemicals and washes.



In cutaway above, the individual units of the photo-multiprocessor are separated to show how sections fit together. In actual installation, units are joined, as shown in the photo above.

Coal Burned In Mine for Fuel Gas

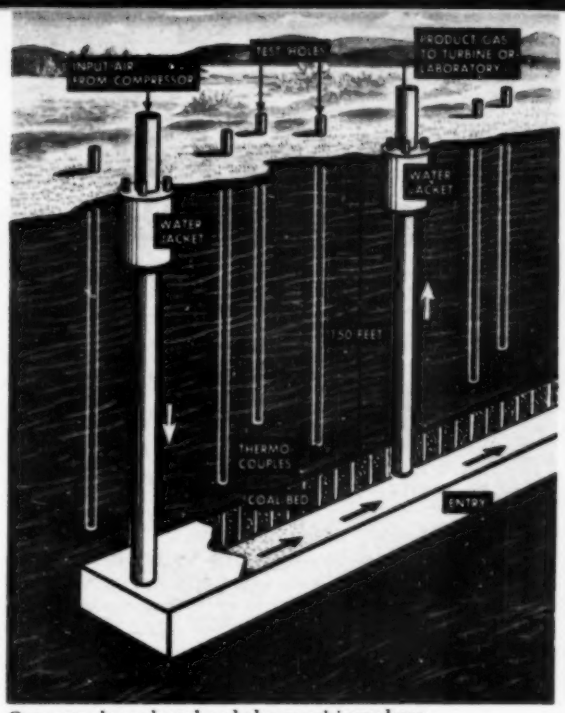
THE day when the coal we burn will never leave the mine is coming nearer. Following the first successful test of underground gasification (PS, June '47, p. 90), the U. S. Bureau of Mines and the Alabama Power Co. have launched a bigger and better project. Behind it is the grim fact of our dwindling oil supplies.

The synthesis gas made from coal—a mixture of hydrogen and carbon monoxide—is a source of gasoline and other hydrocarbons. But this gas is expensive—largely because of the cost of mining and transporting the coal and building generators. If coal can be burned to produce the gas right in the mine, both these costly elements can be eliminated.

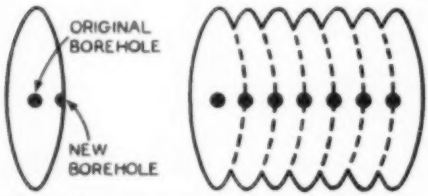
From the new project at Gorgas, Ala., the experts hope to produce a gas that can be put to work. Two parallel entries have been driven 1,200 feet from a coal outcrop into the seam. From a crosscut at their ends extends an additional 300-foot single butt entry. Five large-diameter boreholes have been drilled from the ground's surface above the seam into crosscuts that link the entries every 300 feet.

Engineers have dropped thermite bombs down the borehole farthest from the portals and forced in compressed air to support combustion. Gases are drawn off at the next borehole. The holes farther down the entries may be used to obtain the high temperatures and high carbon-monoxide contents that the engineers want.

Temperature measurements taken from thermocouples in small test holes are keeping track of the fire's progress. If the coal burns out between boreholes in a wide, cigar-shaped cavity, as expected, more holes will be sunk to tap the cavity at its widest point. These, in turn, will be linked into the system as air inlets. Thus the coal can be kept burning indefinitely or until the seam burns out completely. If this doesn't work, another expensive parallel entry will probably be needed to keep the fire going.



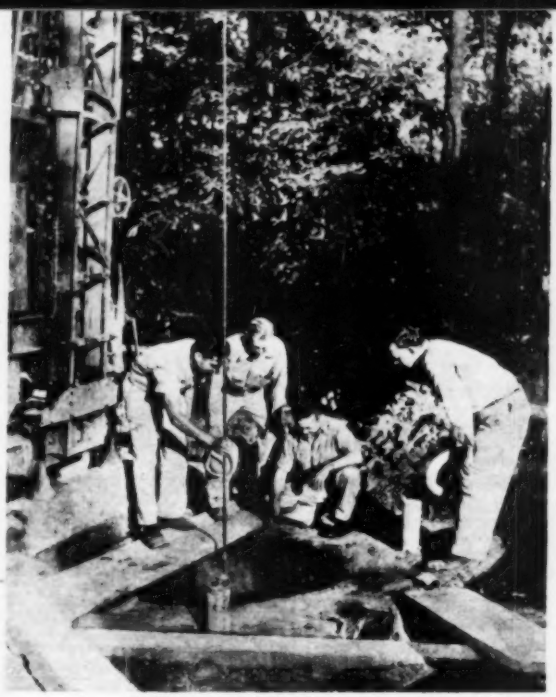
Cutaway shows how boreholes are driven down to horizontal entry, or tunnel. Air is pumped in at 6,000 cu. ft. a minute. Thermocouples will show how far to sides coal has burned.



Hoped-for expansion of burning area with successive boreholes is shown in drawing above.

The Alabama experiments are only one phase of a three-pronged attack on the synthetic-fuel problem. The Bureau of Mines is also experimenting with extracting oil from shale (PS, Feb. '49, p. 130) and from natural gas. But coal is most promising since it comprises more than 95 percent of our known mineral fuel-energy reserves, excluding fissionable materials.

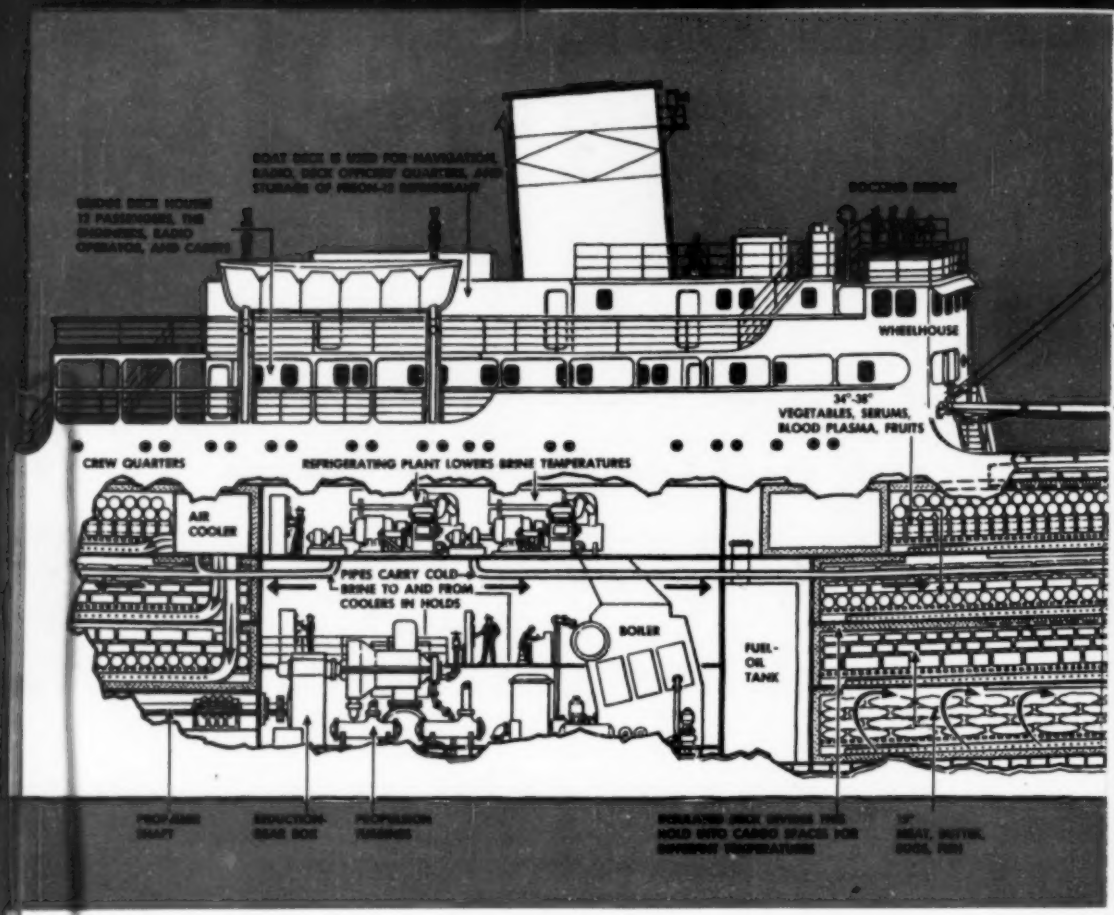
Underground gasification not only bypasses two costly steps in gas production—it will make profitable seams that are too thin to be worked by conventional means. Some day it may make both the miner's pick and the oil derrick as obsolete as the coal-oil lamp. When it does, a lump of coal that never left the mine may supply the power to drive your automobile.



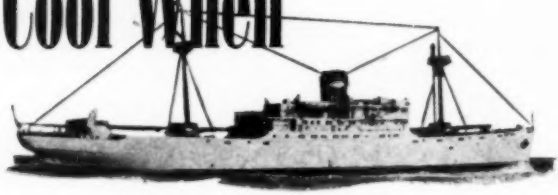
Sinking one of the large-diameter boreholes of the Gorgas project. Holes can either be intake for air or outlet for the gases that result from the underground combustion of coal.

Completed borehole is finished with concrete jacket. Water from a nearby river is pumped into the jacket to produce a spray that keeps the temperature of the exhaust gases below 800° F.

Bureau of Mines experts inspect one of the two horizontal entries driven into the 46-inch-thick seam of coal. The entries, now both sealed at entrance, are connected by crosscuts.



Ship Keeps Cool When Heat Is On

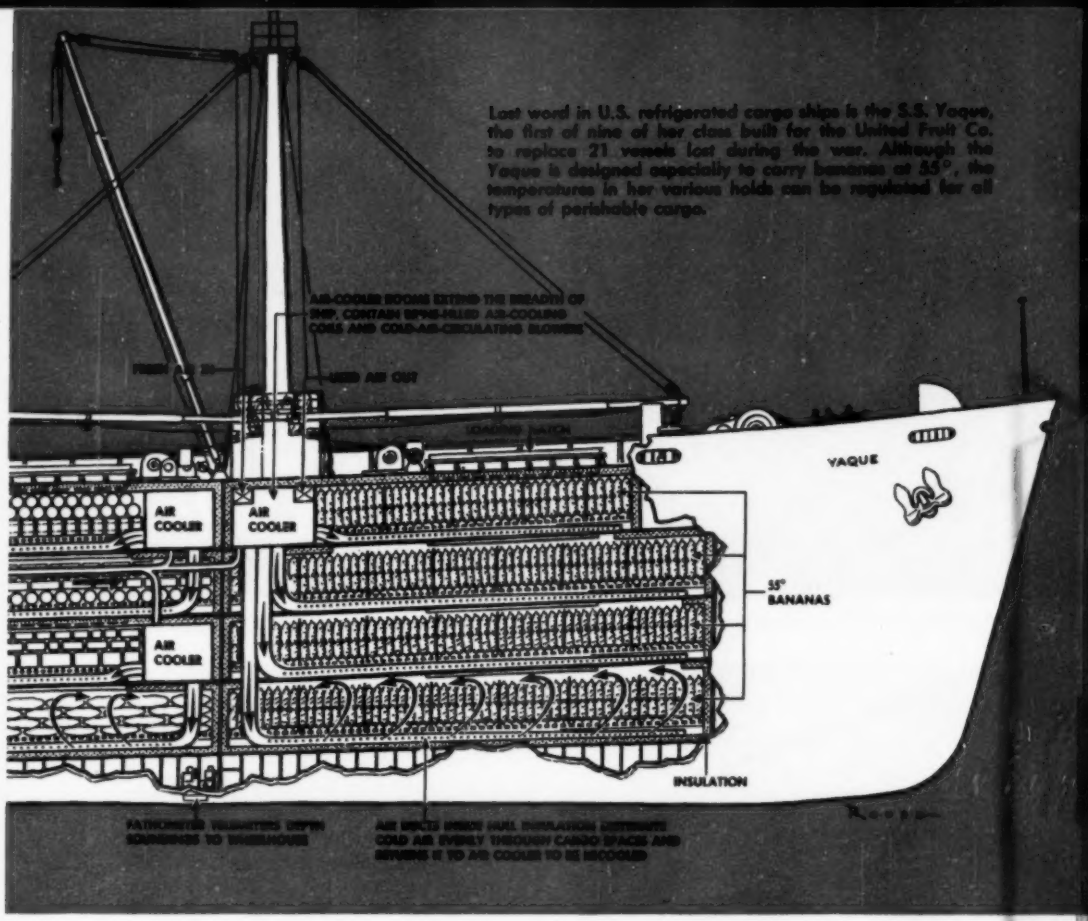


A POPULAR song advises the housewife not to put bananas in her refrigerator. But this sound household advice doesn't apply to the mammoth floating refrigerators—such as the S.S. *Yaque,* shown above—that carry the fruit from its native tropics to northern markets. And for good reasons.

In a home refrigerator, the near-freezing temperature will "kill" the banana, blackening it and making the center soft. But during the long water journey, the extremely sensitive banana must be kept from ripening too rapidly in excessive heat as well as from being "killed" by excessive cold.

Also, in a home refrigerator other foods will absorb a banana's odors. But there's no danger of this in a reefer ship. Each cargo is sealed from the others.

If your home refrigerator were divided into several compartments, the temperatures of which could be separately controlled, you would have an approximate miniature



of the refrigerating system illustrated in this cutaway of the *Yaque*. Its purpose is to let the reefer carry products requiring widely differing temperatures in the same cargo.

Heart of the system is the refrigerating plant that lowers brine temperatures, using Freon-12 refrigerant. From two such plants, the chilled brine is delivered to coils in air-cooler rooms in various parts of the ship.

From these rooms, cold air is sent through ducts to the cargo spaces. There it absorbs the heat released by the food products. The air is then returned to the air-cooler rooms, where the heat is removed by the circulating-brine coils. The brine takes this heat back to the brine cooler and releases it.

The loss of heat recools the brine, which is pumped back to the air-cooler room for another load of B.T.U. The refrigerant that picked up the heat is meanwhile changed by it from a liquid to a gas. This gas is then compressed and discharged to condensers, where the heat makes a final transfer, this time to cold sea water that is discharged overboard. As this heat is removed from the gas in the condensers, the refrigerant returns to its liquid state and goes back to the evaporators to cool brine again.

This patented refrigeration system was designed by United Fruit Co. engineers on the basis of their long experience in the water transportation of tropical fruit. Of many refrigerants available, Freon-12 is used because it is nontoxic, noncorrosive, nonirritating, and noninflammable. The full name of this clear, water-white liquid is dichlorodifluoromethane. It is generally prepared by replacing chlorine in carbon tetrachloride with fluorine. It has a boiling point of −22°F. at atmospheric pressure.

The Yaque-class ships, with a refrigerated cargo space of 195,000 cubic feet, have a speed of 16 knots and a cruising range of 6,820 miles. They carry a crew of 48. END

Whirligig

High-speed cameras catch successive views of model torpedo's flight through air in trial of

Whirligig launcher for model torpedoes lets them fly at predetermined angle with uncanny precision. Electric impulse releases model from spinning wheel at just the right instant.

Ingenious spinning disk hurls dummy "tin fish" into new test tank before the eyes of high-speed movie cameras.

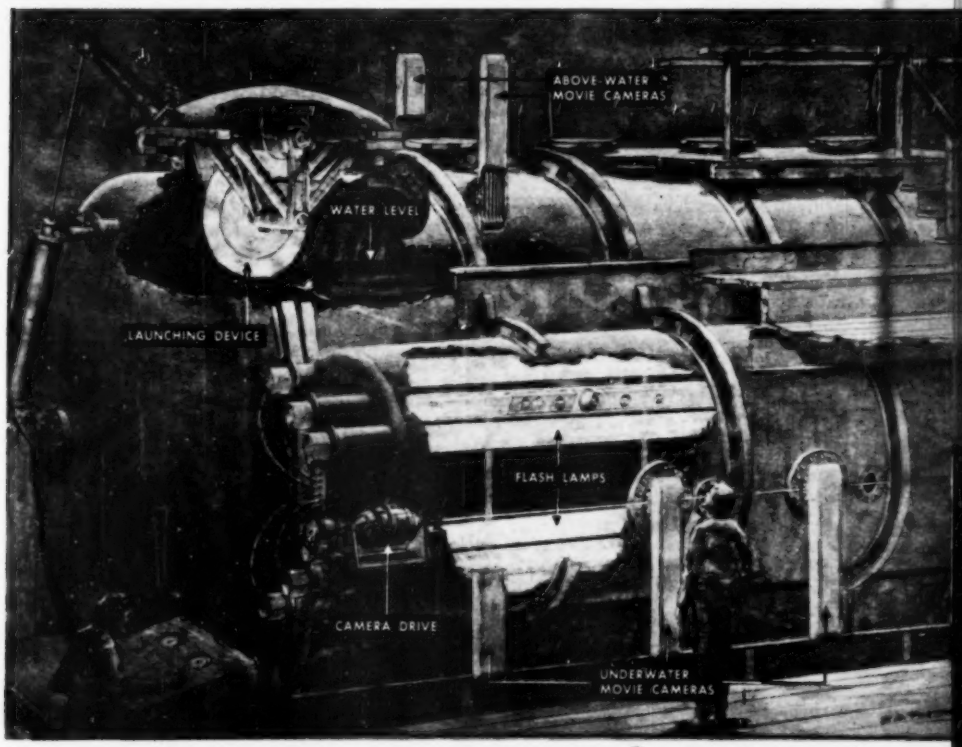
HURLING tiny scale models into water at controlled speeds up to 188 miles an hour, a mechanical whirligig at the California Institute of Technology tests newest designs for air-launched Navy torpedoes. High-speed photos then tell whether the full-sized missile will enter the water cleanly and run true to its target.

Built into a cylindrical tank 29 feet long, the model launcher is really an ultra-accurate sling. A spinning, motor-driven disk holds the steel and aluminum model in a chuck. Precise gears keep it aimed in the same direction as the wheel spins. Spring-actuated jaws of the chuck fly apart virtually instantaneously when tripped by a solenoid. This lets the model fly in any direction, the tiny torpedo traveling either head-on or tilted at an angle to its line of flight. In a dramatic demonstration of the launcher's precision, it catapulted a model 2 inches in diameter squarely through a 2⅝-inch hole in a target 15 feet away.

Film races continuously through movie cameras at portholes of the tank, each taking up to 3,000 frames a second. To stop motion, Edgerton-type lamps in tubular holders provide intermittent flashes of only 2/1,000,000-second duration. END

Tests Navy Torpedoes

launcher. Passing through hole in above-water test target, model scores bull's-eye above.



Cutaway view of launching tank shows apparatus for launching model torpedoes and studying their behavior, including whirligig launcher, battery of high-speed cameras, and lamps that provide intermittent split-second illumination for photography. Model torpedoes may be launched at any angle from vertically downward to parallel with the surface of the water in the test tank.

175-Acre Farm Rebuilt In Eight-Hour Day

Mrs. Thrasher's valley farm has a new lease on life—and offers the same hope to American agriculture.

By John F. Loosbrock

IF YOU had visited the Thrasher farm a year ago, you wouldn't know it today. What has happened to its 175 acres, near Frederick, Md., is a kind of miracle: a miracle deliberately planned to show America's farmers how to save the countryside—and fatten their pocketbooks at the same time.

The whole thing took place in a day. Between morning and evening milking, the farm was converted from a wasteful, old-fashioned, straight-row-cultivation $13,000 farm into a model soil-conserving milk factory worth $25,000 to $35,000.

In the 200 years since it was carved out of the forest the farm's never been handsomer than it is this spring. Green pastures roll where last year saw ugly, worthless gullies. Strips of wheat, corn, and grass march in contrasting bands over the gentle hillsides, where last year straight rows filled the fields. A new barn and silo gleam. Mrs. Nellie Thrasher and her two teen-age children are looking forward to a lot of fish dinners from the bass and blue-gills that lurk in the new fish pond. They are expecting more milk, more meat, and generally better crops, too.

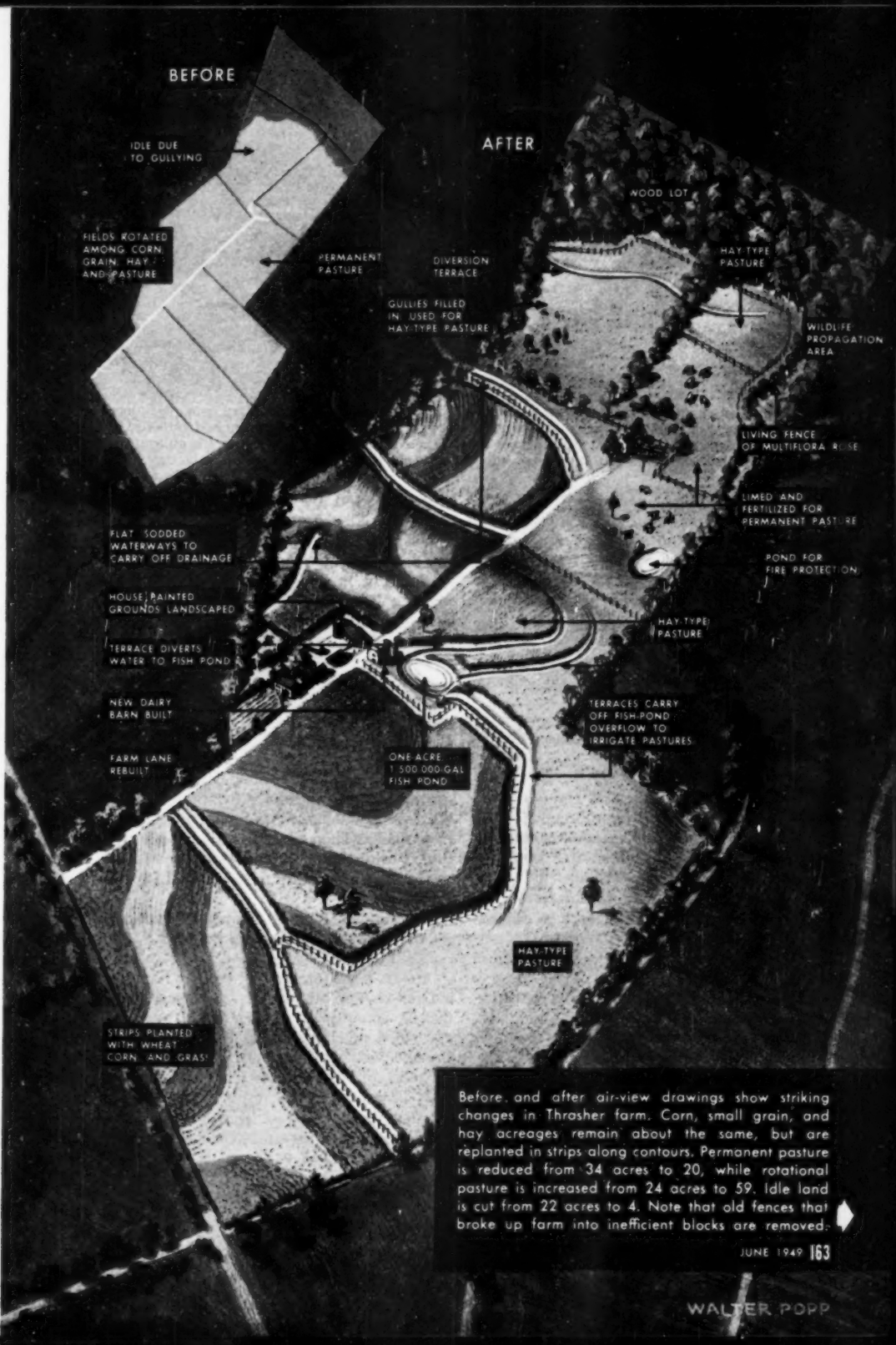
Zero hour was 9 a.m. last August 18. Five-hundred volunteer workers, armed with nearly half a million dollars worth of farm machinery and heavy-duty earth-moving equipment, descended on Nellie Thrasher's place. By dusk that evening, when the last bulldozer waddled home, the job was done.

Before a crowd of 40,000, this modern counterpart of the oldtime husking-bee had ripped out all except the boundary-line fences, put in 600 rods of new contour fencing, dug two ponds, and built a mile of farm roads. A hundred tons of lime and 25 tons of fertilizer had been dusted on the starved soil, which was then sowed with almost a ton of grass seed and 100 pounds of grain. Obsolete straight-row cultivation, with its troughlike furrows, had been replaced with scientific strip cropping to conserve moisture and precious topsoil.

Raw gashes in the eroded pastures had been bulldozed in and seeded down. An up-

The results of 200 years of hard farming show in this view of the Thrasher farm before rebuilding. Note gullies at foot of hill. From 25 to 75 percent of the topsoil is gone from this field.

Late on rebuilding day finds contours plowed, new barn and silo. White line across foreground is diversion terrace; white strips at foot of hill are where gullies have been filled in and limed.



Before and after air-view drawings show striking changes in Thrasher farm. Corn, small grain, and hay acreages remain about the same, but are replanted in strips along contours. Permanent pasture is reduced from 34 acres to 20, while rotational pasture is increased from 24 acres to 59. Idle land is cut from 22 acres to 4. Note that old fences that broke up farm into inefficient blocks are removed.

WALTER POPP

Morning of one-day farm face-lifting brought a half-million dollars worth of farm machinery and heavy dirt-moving equipment, 500 volunteer workers, and tons of materials streaming into Thrasher farm like long military convoy. Before long, crowd of 40,000 spectators had gathered to watch transformation that turned the antiquated farm into a modern, efficient milk factory.

to-date concrete and corrugated-aluminum dairy barn, complete with steel stanchions, drinking troughs, and milkshed, was ready for the critical inspectors of the Washington, D. C., milk buyers. A concrete-stave silo not only had been built but had been filled with fresh-cut corn silage from the Thrasher fields.

The old farmhouse had been repaired with lumber cut from the Thrasher wood lot, painted, and insulated. The lawn had been graded, tiled for drainage, and landscaped. Ancient shade trees had been expertly manicured by professional tree surgeons.

4,000 Man-Hours

Conservatively pricing the time of the 500 workers at $1,000 an hour, $8,000 worth of man-hours (from unskilled laborers to $30-a-day technicians) had torn the farm to pieces and put it together again. It would have taken Mrs. Thrasher, or any farmer of limited means, four or five years to do the same work. And, except for paying a substantial part of the cost of the new barn, Nellie Thrasher hadn't laid out a cent.

Her farm was picked to show the people of Frederick County, plus the thousands of spectators from all over the Middle Atlantic states, how sound conservation practices not only can help preserve priceless soil for future generations but can mean dollars in the farmer's pocket today. Similar one-day demonstrations have been staged by the U. S. Soil Conservation Service and other conservation agencies in a dozen states.

But the Frederick show was one hundred percent local, both in conception and execution. Started by the Frederick County Pomona Grange, it snowballed into a county-wide project. Machinery, equipment, material, labor, and money were donated by the farmers, merchants, and bankers of the county. State and federal agencies contributed only what assistance is normally available to farmers anywhere, any time.

An incident a few days before the demonstration illustrated the community's mood. During a heavy rain an old farmer in boots and overalls walked into demonstration headquarters in Frederick.

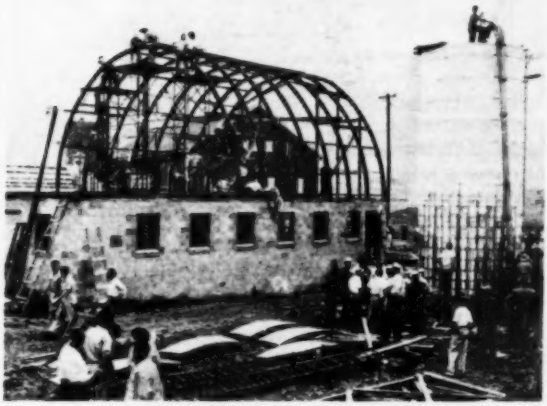
"I'm an old man," he said. "I came in by the river road this morning. I saw the rain washing topsoil off the fields into a roadside ditch—topsoil that isn't near what it was when I was a boy. Then I looked at the Monocacy River, heavy with silt, carrying the richest soil in Maryland out to the sea. We'll have to stop that."

He drew $25 from his pocket—his personal contribution to the more than $10,000 donated.

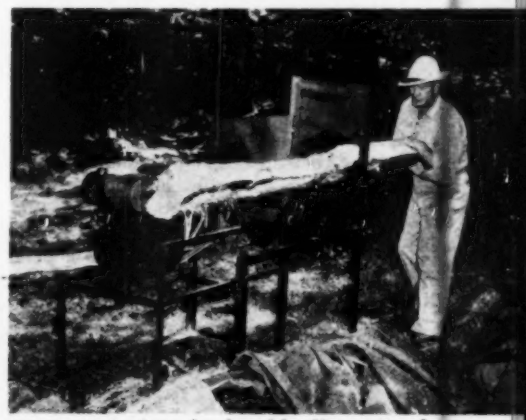
A farm-selection committee, including local Soil Conservation Service technicians and district supervisors, picked Mrs. Thrasher's place for several reasons. It was a typical Frederick County farm. On it almost all conservation practices could be illustrated. Since Mrs. Thrasher's brother-in-law was an ardent conservationist, the good work begun during the demonstration would most likely be followed up. It was well located to handle crowds of visitors. And, as the sponsors frankly admit, Mrs. Thrasher's widowhood lent a personal appeal to the publicity angle.

Mechanized posthole diggers did spadework for 600 rods (9,900 feet) of contour fencing. Posts, cut and hauled from farm's own wood lot, were then erected as fast as holes were finished.

Maryland National Guardsmen used walkie-talkie radios to direct and coordinate work parties scattered over 175 acres. Whole operation had the split-second timing of a military maneuver.

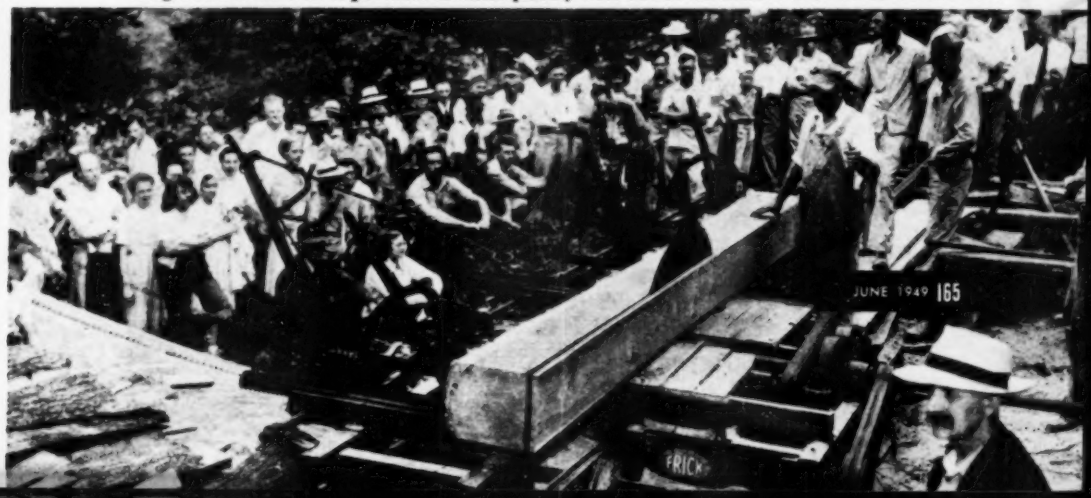


New dairy barn was nearing completion by early afternoon. Quonset-type superstructure on concrete-block foundation was covered with corrugated aluminum. Barn meets rigid standards.



Automatic barker, developed by University of Maryland Extension Service, peels bark from black locust logs for fence posts. Lumber for repairs was also cut right from farm's wood lot.

Huge crowd looks on as portable sawmill quickly cuts one of Thrasher trees into usable lumber.



Spruced-up farmhouse now boasts new paint, repairs, and mineral-wool insulation in attic. Tree surgeons worked on fine, old shade trees while lawn was graded, landscaped, and seeded.

Soil Conservation Service experts looked over the farm and noted on an aerial photograph how the land was being used. Then, based on their estimates of the land's true capabilities, they drew up a new land-use map. Amounts of seed, fertilizer, fencing, other materials, and labor were estimated. A neighboring farmer and long-time conservationist, L. H. Crickenberger, was named general manager. He rounded up volunteers, solicited donations, named working teams, and coordinated all activity in a 16-page pamphlet that made an Army field order seem vague in comparison.

While Maryland National Guardsmen with jeeps and walkie-talkies kept in touch with workers scattered over 175 acres, the whole show went off with the slick precision of a Notre Dame touchdown play.

Fifty two-plow tractors turned up the strip contours and helped a whirlwind terracer build 4,500 feet of diversion terraces for run-off water. Eleven grain drills sowed fertilizer and grass seed on 24 acres of hay-type pasture land. Thirteen lime sowers treated 20 acres of permanent pasture. Nine bush and bog harrows and four disk tillers cut up sod land for sowing with grass and clover. Four spring-tooth harrows pulverized plowed land for seeding. A dozen mechanical post-hole diggers bored holes for 600 rods of new fencing. And 12 1½-ton trucks hauled fencing, lime, fertilizer, and seed to the various operations.

Eleven bulldozers rooted out old fence lines and helped scoop out the ponds and build roads. Three heavy road graders rated an assist on the terraces, the ponds, and the road construction. Two huge carryalls carted rocks that had accumulated during years of plowing to line the banks of a small creek that runs by the farm—then moved over to help with the ponds.

That all this will pay off, not only for Mrs. Thrasher but for any conservation-minded farmer, is shown in estimated yields for this crop season as opposed to last year. These boosts in production are anticipated: corn and small grain, 10 percent; hay, 400 percent; and pasture 200 percent. This means that this year Mrs. Thrasher will be able to sell more gallons of milk per dollar invested. And she won't have to buy high-priced corn to carry her cattle over, as she did last year.

Best of all, her 17-year-old son, Edward, has been thoroughly indoctrinated in conservation practices and will carry on. And the farm will become more fertile and productive through the years. In the words of an anonymous poet, printed on the programs distributed at the demonstration:

Hordes of gullies now remind us
We should build our lands to stay,
And departing leave behind us
Fields that have not washed away;
When our boys assume the mortgage
On the land that's had our toil,
They'll not have to ask the question,
"Here's the farm but where's the soil?"

END

Suitcase Station 'Explodes'

A MINIATURE gasoline service station that "explodes" before the audience's eyes is used by the Ethyl Corporation to dramatize the dangers of careless handling of gasoline. This portable diorama is completely housed in a box about the size of a suitcase. The lid opens to form a backdrop. Below the models is all the mechanism, fitted into the bottom.

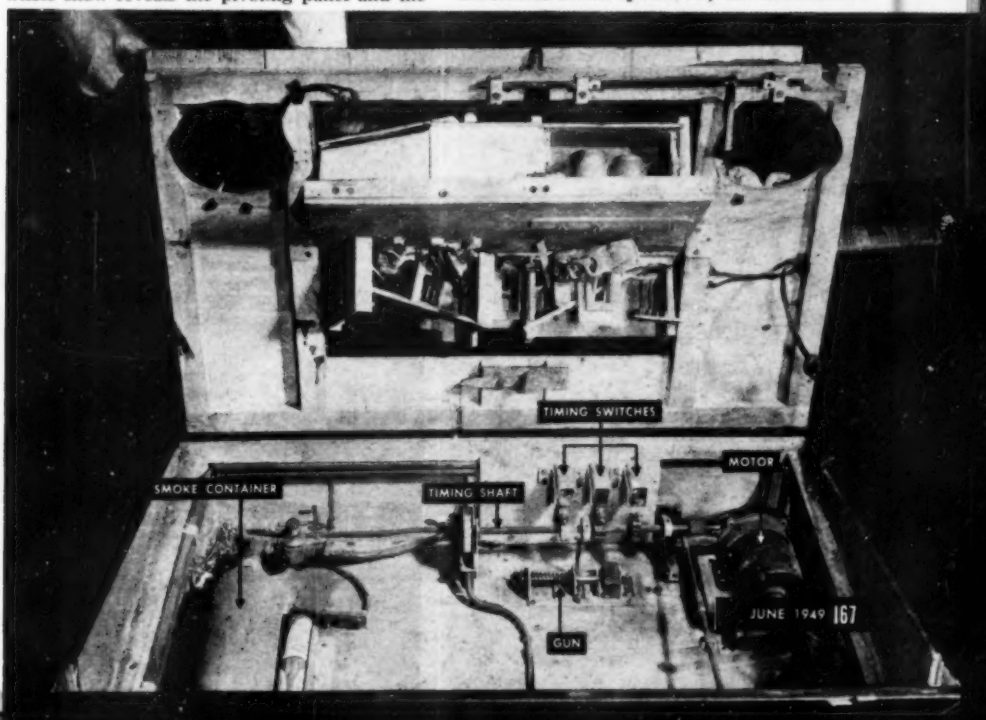
The blast of the "explosion" is accompanied by a bright flash of light, seen through one of the doors, and a cloud of smoke. While the viewer is slightly dazed, the station is instantly replaced by smoking ruins of the building and automobiles.

The exploding service station is part of an Ethyl show that drives home fire risks.

Model gasoline station at start of simulated explosion. A flashbulb goes off inside the building at the same time a .38 blank cartridge is fired, providing realistic visual and sound effects.

The models of the station before and after the explosion are fixed to opposite sides of a pivoted panel. At the instant of the explosion, release of a catch flips these smoking ruins into place.

This view inside the suitcase that contains the whole show reveals the pivoting panel and the mechanism, which is actuated by a remote-control release device operated by the demonstrator.



Biggest Dipper Has a 55-Cubic-Yard Bite

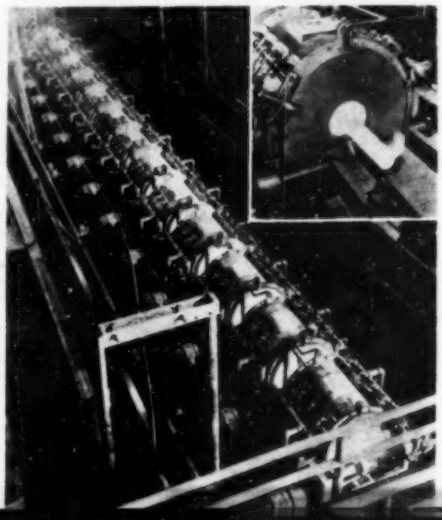
THIS giant scoop bucket, largest on earth, can pick up 55 cubic yards of earth in one bite. When mounted on the end of a 54-foot-long boom riding on caterpillar treads, the 11- by 13- by 12-foot dipper will cut a swath 80 feet deep and 90 feet wide without moving from one spot. To be electrically powered, it was made by the Lukens Steel Co.

Big Dredge Deepens River

ANOTHER "biggest" is this new cutter-type, hydraulic-suction dredge, largest ever built. Busy deepening sections of the Colorado River, it's 130 feet long and has a displaced weight of 500 tons. Its 20-inch pipeline carries off up to 1,800 cubic yards of dredge material an hour. Built by the Pacific Coast Engineering Co., it cuts channels up to 300 feet wide and 20 feet deep.

"Doughnuts" Heat Tubes

THIS long furnace, composed of 13 separate doughnut-shaped heating units (inset), heats pierced seamless steel tubing at the National Tube Co. in Gary, Ind., so that it can be rolled to size. Temperature of the tubing is controlled by varying its speed as it passes through the "doughnuts" on a conveyer. Electric eyes register a tube's color and then speed it up or slow it down.



Lightweight Chaise Longue Serves as Auto Bed

EASILY portable, this chaise longue with a reclining back provides plenty of comfort on camping trips or just for a lazy afternoon at the beach. Two of them fit snugly into the rear of a station wagon to serve as auto beds. Made of a tubular aluminum alloy, they also may be carried on the top of a sedan. The back is adjustable to various angles for use as a chair, or it may be laid flat to form a bed. An 11-lb. pad serves as the mattress. The manufacturer is the Auto-Bye Company, of Los Angeles. Retail price is about $50.

Light Signals Overdrive Cut-in

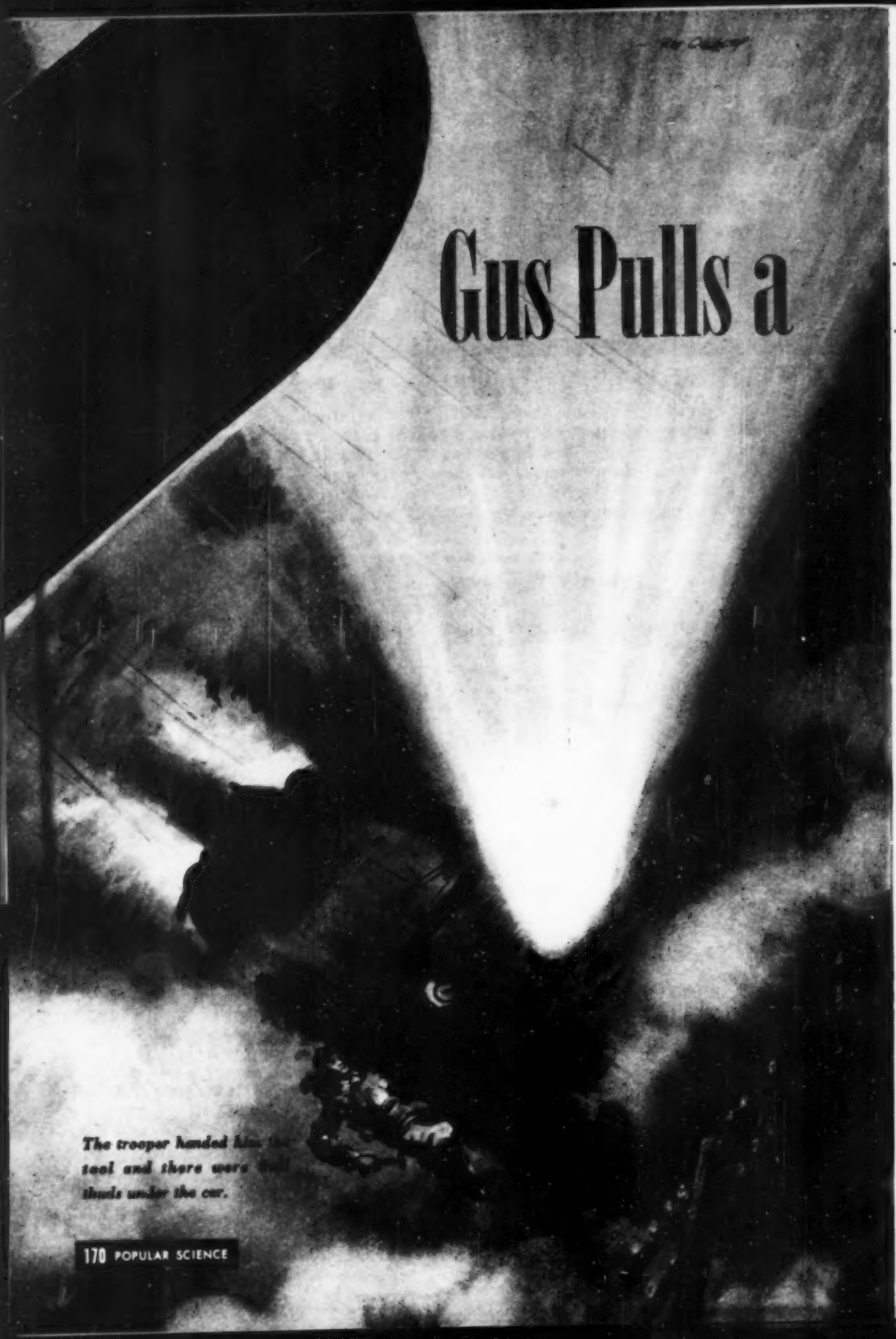
IF YOUR car is equipped with overdrive, this light will provide a visible signal that you have reached cut-in speed. When the light comes on, you know it's time to let up on the gas pedal momentarily. It remains on throughout the overdrive speed range.

Marketed by C. D. Hill Products Co., of Chicago, for about $2, the Overdrive Sig-na-lite® is wired to the overdrive relay. A clamp is provided to attach the green light to the instrument panel. The light remains off when the car is in regular gear.

Magnet Holds Spare Key

THIS little gadget—holding that extra car key—magnetically hooks on to practically any spot on your car. The base is an Alnico® magnet that holds 100 times the weight of the case. You can stick the case and extra key under the car, behind the radiator grille, on the inside of a bumper, or in other places. Then, if you absently lock the car with the key left in the ignition lock, or if you lose your key, you still have that extra key available. It's priced at 50 cents by Vizerak Co., Inc., Milwaukee, Wis.

Gus Pulls a



The trooper handed him the tool and there were two thuds under the car.

When Gus beat weather and a jammed transmission to rescue a lost plane, he didn't know he was saving himself from doing Joe's job.

Plane Out of a Hole

By Martin Bunn

FOR the third time that morning, Gus poked his head into the office and scowled at Joe Clark's empty chair.

"I ain't heard nothing yet, Mr. Wilson," Greg Jones told him. Greg, the grease monkey, had been delegated by Gus to answer the phone while the other partner of the Model Garage was away. Reading the sport page of the morning paper, Greg was enjoying his new, but temporary, duty.

"Well, let me know the minute you hear anything," Gus said. He glanced at the clock and walked back to the shop, muttering. Coming up that afternoon was a bit of business Gus didn't like—paper work involving renewal of the garage lease. Gus had little patience with any kind of paper work. Joe handled all that for the garage.

"Why the dickens did he have to pick yesterday to visit his sister?" Gus mumbled.

"What'd you say, boss?" Stan Hicks asked.

"Just wondering what's keeping Joe," Gus said. "It's not more than a few hours' drive from his sister's place. If he left there early this morning, as he said he would, he'd be here by now."

"Maybe the weather gummed him up," Stan suggested.

The day had begun fair enough, but a low-lying bank of clouds had rolled in, bringing with it a steady drizzle.

"Even so," Gus insisted, "he ought to be here by now unless something's gone wrong."

Greg came out of the office at a run. "Mr. Wilson!"

"That must be him now," Gus said, starting for the office.

"It's Mr. Corcoran, the state cop," Greg spluttered excitedly. "He wants you. He says it's an emergency and you gotta talk to him."

Trooper Jerry Corcoran's voice crackled over the wire. Greg could dimly hear the squawking noises from the phone, but he couldn't make out what was said.

"Yes," Gus said, "we could but it would take too long."

More crackling noises came from the phone. Greg strained his ears to hear.

"Of course I understand he's in a spot," Gus snapped. "Hold on now. Let me dope this out." Gus scowled at the far wall for a moment. The phone was silent. "I think I've got it," he went on. "Come over here as fast as you can. By the time you get here, we'll have an emergency rig ready to install. I've got everything I need—no I haven't either. Stop at a radio shop and pick up a dozen small alligator clips . . ."

Plane on a Spot

The phone squawked again.

"What?" Gus yelled.

More squawking.

"Alligator clips—alligator," Gus repeated. "A-l-l-i-g-a-t-o-r," he spelled.

Another crackle from the phone.

"That's right," Gus said, "and step on it." He dropped the phone in the cradle and hurried back into the shop.

Stan knew there was something unusual in the wind the minute he saw Gus.

"What's cooking?" he asked.

"There's a plane lost in that muck up top, and probably low on gas," Gus explained. "Jerry Corcoran was going to try to guide him into the airport with his spotlight, but the light's control linkage won't swing the beam up far enough. We've got to have an emergency lamp ready to put on his car when he gets here."

"Holy cow. How're we going to do that?"

"Get me three sealed headlight units out

of the stockroom," Gus said. "Bring them in their cartons. And get some heavy cord, too."

While Stan hurried to the stockroom, Gus cut several eight-foot lengths off a reel of insulated wire and stripped the ends. Then he pulled a board about five feet long from under his workbench. Stan returned with the headlight units and cord.

"Get me that stapler off Joe's desk," Gus told him. Stan left at a run while Gus tore the covers off the stiff cardboard cartons that held the lamp units. He was waiting for the stapler when Stan returned. Gus swiftly stapled the cartons together and then tacked them to the board.

"Here he comes," Stan said.

Light Up the Overcast

A siren shrieked and then died away to a moan as the police car shot past the gas pumps and into the garage.

"Make it fast," Corcoran called as he stepped out of the car. "That guy up there could run out of gas."

"Gimme those clips and keep out of our way," Gus told him.

The trooper handed over the alligator clips, and Gus quickly went to work. He attached clips to both ends of each length of wire. Then he clipped the leads to the prongs of the lamp units so both filaments would be energized. Next he ran a ground to the car's frame.

"That'll make each lamp equal in power to two headlights," he told Stan. He replaced the last unit, lens up, in its corrugated-cardboard nest in its carton on the board. "Here, give me a hand."

Stan helped him place the board across the car's top and lash it in place with cord passed through the rear windows. While Stan finished tying down the board, Gus clipped the free ends of the leads to the wire running to the cigarette-lighter connection behind the dash.

"Those lights will cause a heavy overload, especially with the radio going," Gus explained to Corcoran. "We can't risk blowing a fuse and this way their draw won't run through the fuse . . . let's check."

A vivid splash of light glared on the garage ceiling.

"Okay, Jerry, get going," Gus said.

"You better come along," Corcoran said. "Something might go haywire with that rig."

Headlights gleamed mistily through the drizzle as the trooper swung the car out of the drive and into the highway. The ceiling was even lower. Ragged streamers of scudding clouds hid the hilltops from time to time.

"The guy who's lost is in a lightplane over Daggettsville, eight miles from here," Corcoran shouted to Gus above the siren's scream. "They phoned in to say he's circling low over the crossroads."

"Step on it," Gus told him.

Corcoran stepped on it. He drove hard but expertly, and they covered the eight miles in nine minutes.

Daggettsville is a general store and a dozen or so houses at a crossroad. Most of its population was in front of the store, staring up at the gray sky. Gus and Corcoran jumped out of the car. Somewhere overhead was the plane. They could hear the sound of its engine. Gus connected the emergency lamps and a shaft of light stabbed skyward.

"Here he comes again," someone shouted. The plane, so low it just seemed to clear the house tops, skimmed over the crossroads and through the beam of light. The pilot waggled his wings and the plane disappeared into the overcast.

"He saw us all right," Corcoran said. They climbed back into the car and the trooper drove south several hundred yards. "I hope he understands he's to follow the light. It's only ten miles to the airport by this road. What's the slowest one of those things can fly, Gus?"

"I guess he can throttle back to about 50 or 55," Gus answered.

"He's apt to get ahead of us then," Corcoran said. "We can't count on averaging 50 in this weather, especially when we run into heavier traffic down the road."

"If you can do 45, it'll be all right," Gus told him. "He can stay behind us by flying S-turns . . . here he comes again."

Waggling its wings, the plane once more flew through the light beam.

"He's going to follow us," the trooper said. He put the patrol car in gear and started along the highway. Luckily traffic was thin. They hit 60 most of the time with the plane hanging close to the light beam.

Trouble with a Rock

"I think he'll make it," Gus said. "If he's got enough gas."

"There's a short cut along here that'll save a couple of miles," Corcoran said. "I'm going to take it."

A moment later he swerved off the highway and into a farm lane. After a few hundred yards, the lane degenerated into a pair

of rock-strewn, water-filled ruts. Corcoran slowed the car only a little. They dipped into a brook, scattering gravel and plowing through it in a shower of water.

"Another hundred yards and we'll be back on the highway," the trooper said. Then they approached the main road. A steep grade led up to it. Corcoran put the car in low. Wheels spinning on the loose, rocky surface, the patrol car pulled out on the highway.

"Step on it," Gus urged.

"I can't," the trooper yelled. "Something's wrong with the gearshift lever. I can't get it out of low." They crawled along at 20 miles an hour, the plane circling around the light beam. "I shouldn't have taken that short cut."

Gus had been doing some hard thinking. "Stop the car," he told Corcoran. "If it's what I think it is, I might fix it in a hurry."

Corcoran jammed on the brakes and Gus dove under the car with a flashlight. Then he yelled for a hammer. The trooper pulled it from the tool box and handed it to him. There were several dull thuds under the car. Then Gus pulled himself out, shaking water from his coveralls. Overhead the plane still circled the vertical beam.

"It's okay now," he said. "There was a stone jammed between the shift levers running back from the steering column."

Corcoran pushed the car along at almost 50 and in a couple of minutes the plane shot ahead of them.

End of the Race

"He sees the airfield lights," Corcoran said. "Good thing you were along, Gus. Let's go see who the guy is."

They drove into the field in time to meet the pilot as he walked toward the administration building. He was a gangling youngster. When he saw the improvised lights on the patrol car, he stared for a moment and then broke into a broad grin.

"I never thought I'd want to kiss a cop," he grinned, shaking Corcoran's hand hard.

The trooper laughed. "What are you flying around in this weather for?" he asked.

"I live over in Middleburg," the pilot explained. "I only got my private ticket last month, and when my uncle dropped in to see us, I took him up for a ride. He'd never been in a plane before."

"He sure has now," Gus put in.

The pilot laughed. "The ceiling was high at Middleburg and I guess I flew farther than I intended. Then before I knew it, the ceiling dropped in on me and it began to rain. I was just plain lost. I guess I should have put it down in the first pasture I saw instead of looking around for an airport."

"That probably would have been your best bet," Corcoran said.

"I'll learn . . . I hope," the pilot grinned. "Anyway," he went on, "I finally found that little town where you picked me up. I was circling it, trying to get a bearing . . . here comes my uncle. He's really wrung out."

Wrung out was a perfect description of Joe Clark as he came slowly toward them. When Gus saw his partner, his jaw dropped and then he laughed.

"Well," Gus said, "you finally made it . . . after I went out and dragged you half way in. If I'd known you were in that plane, I'd have sweated a lot more."

"Why, that's darn nice of you, Gus. After all, we've been together twenty years . . . I mean, it's good of you to worry about me," Joe floundered.

"You, nuts!" howled Gus. "It was me I'd have worried about. I sure wouldn't have wanted to sweat over that new lease by myself!" END

Rear Engine Drives Front Wheels

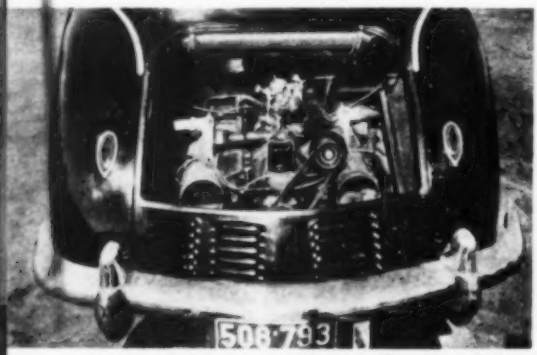
FRONT drive and a rear engine are combined in the Gregory®, a lightweight car designed and built by a Kansas City engineer. Present plans call for production this year and a price of about $1,000.

A 125-lb. air-cooled aircraft engine was redesigned especially for use in the car. It develops 40 hp. at 3,000 r.p.m. and gives a top speed of about 70 m.p.h. Fuel consumption is 30 to 35 miles per gallon.

Developed in 1923, the front-drive mechanism has been tested in a series of pilot cars since then. Previously, the lack of an efficient power plant forestalled attempts at production, but inventor Ben F. Gregory feels the present engine does the job required.

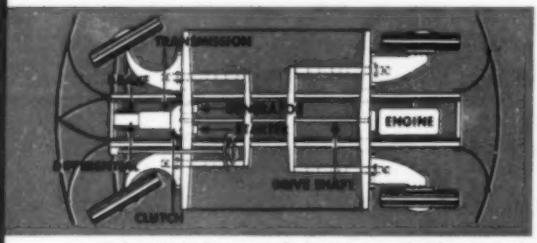
All wheels are carried on flexible arms instead of axles. Built as a unit with the springs, these arms trail at the rear and project forward at the front. The drive passes through the front arms and the front wheels pivot on their own centers.

Three ride in front, two at rear in 1,900-lb. car built by Ben F. Gregory, of Kansas City. It has 94" wheelbase, is 153" long, 67" wide.

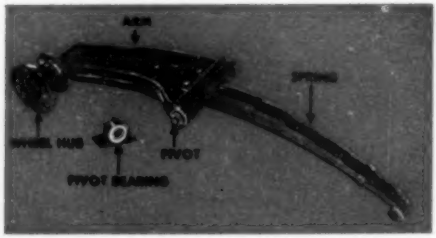


Air-cooled engine at the rear develops 40 hp. It's an L-head type with four opposed cylinders.

Louvers in body allow flow of engine-cooling air. A blower on flywheel speeds circulation.



Schematic layout of chassis reveals absence of ordinary axles. Tubes form the frame backbone.



Wheels are mounted on pivoted arms, both at front and rear. Spring extends into the arm.

Count 'em! Five adults can squeeze into the single seat of car built by Bill Huckins, at wheel.

Homemade Convertible Rides Five on One Seat

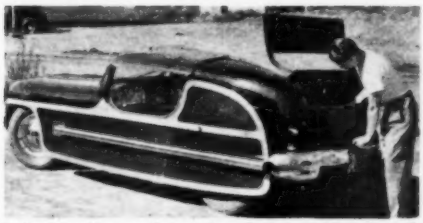
LOW, wide, and handsome, this homemade convertible shows that ultramodern lines can be achieved with conventional parts if you put them together with imagination. The car is the work of Bill Huckins, of Yakima, Wash.

The Huckins Special includes a Chevrolet chassis and engine, a grille and front fenders from a Ford truck, a radiator from a Jeep, and dash instruments from a Plymouth. To these components, Huckins added liberal dashes of plywood, aluminum, clear plastic, and other odds and ends. The finished car is 48" high and 60" wide.

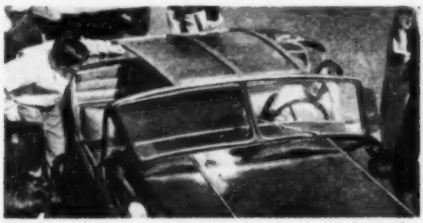
To make the hood, Huckins cut off the front halves of the truck fenders and welded them to flat sheet metal. A sliding center panel gives access to the engine.

Car has no doors. You step in and out over the side after sliding back the clear plastic panels.

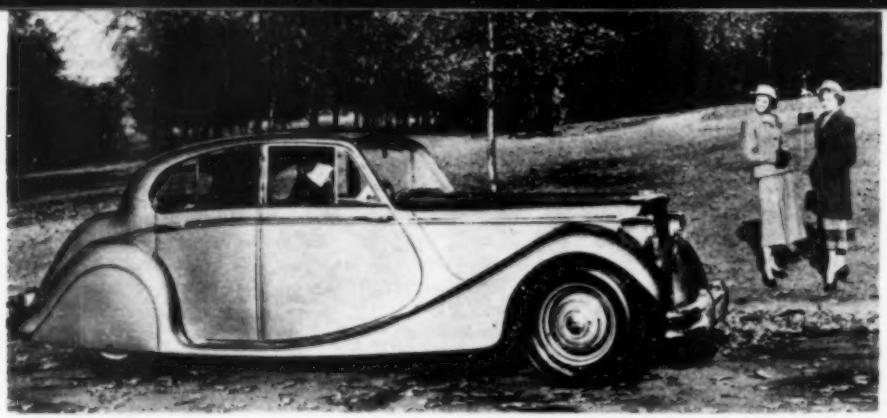
Cockpit was designed for elbow room. Note tip of the gear lever near the driver's left hand.



Side panels are plywood and composition board. Rear corners of body are fenders from a truck.

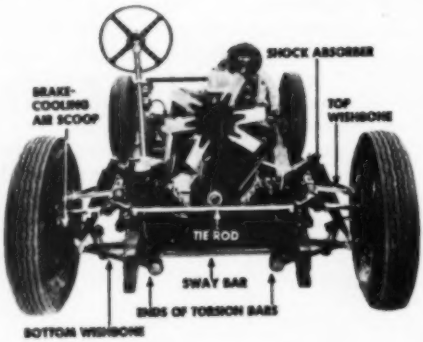


Designed for sunshine, the top consists of a rigid center with sliding panels on each side.



A luxury import from Britain, the Jaguar Mark V® sedan is about the size of a medium U. S. car.

New Jaguar Has Twist-Bar Spring



NEITHER coil nor leaf springs are used in the independent front suspension of the 1949 Jaguar Mark V® sedan and convertible. Instead, it uses torsion bars combined with wishbones and hydraulic shock absorbers.

A high-performance import from Britain, the Jaguar sells here for about $4,600 for the sedan, $4,700 for the convertible. Built on a 120″ wheelbase, it is 180″ long, 68⅜″ wide, and 62⅝″ high. There's a choice of two 6-cyl. engines, the smaller developing 102 hp., the larger 125.

The new front suspension is said to give excellent road-keeping and cornering performance. A rugged rear arm on the lower wishbone connects to a torsion bar. The two torsion bars parallel the main front chassis members. An anti-roll, or sway, bar connects the lower wishbones. Longitudinal leaf springs are used at the rear of the car.

Chain Drives Belly-Tank Midget at 45 M.P.H.

SOME observers might consider this three-wheel vehicle a car, but the state of California has licensed it as a motorcycle.

Emory Stanfield, of Los Angeles, built it from a P-38 belly tank. As converted, it measures 13′ from end to end, weighs 500 lb., speeds along at 45 m.p.h., and travels 114 miles on the two gallons that fill its tank. A one-cylinder, 5½-hp. engine drives it by means of a chain to the single rear wheel.

Mechanics and Handicraft

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Choosing the Right Hinge PAGE 184

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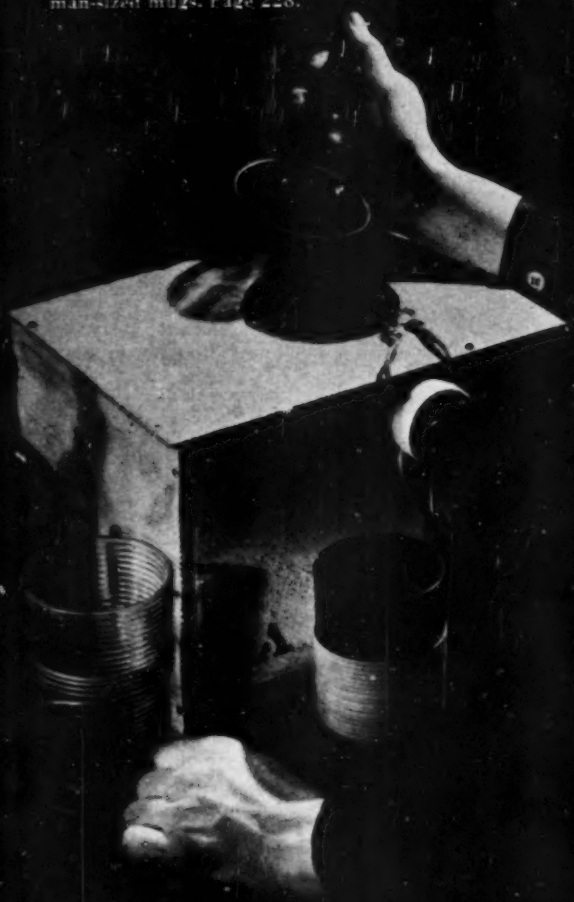
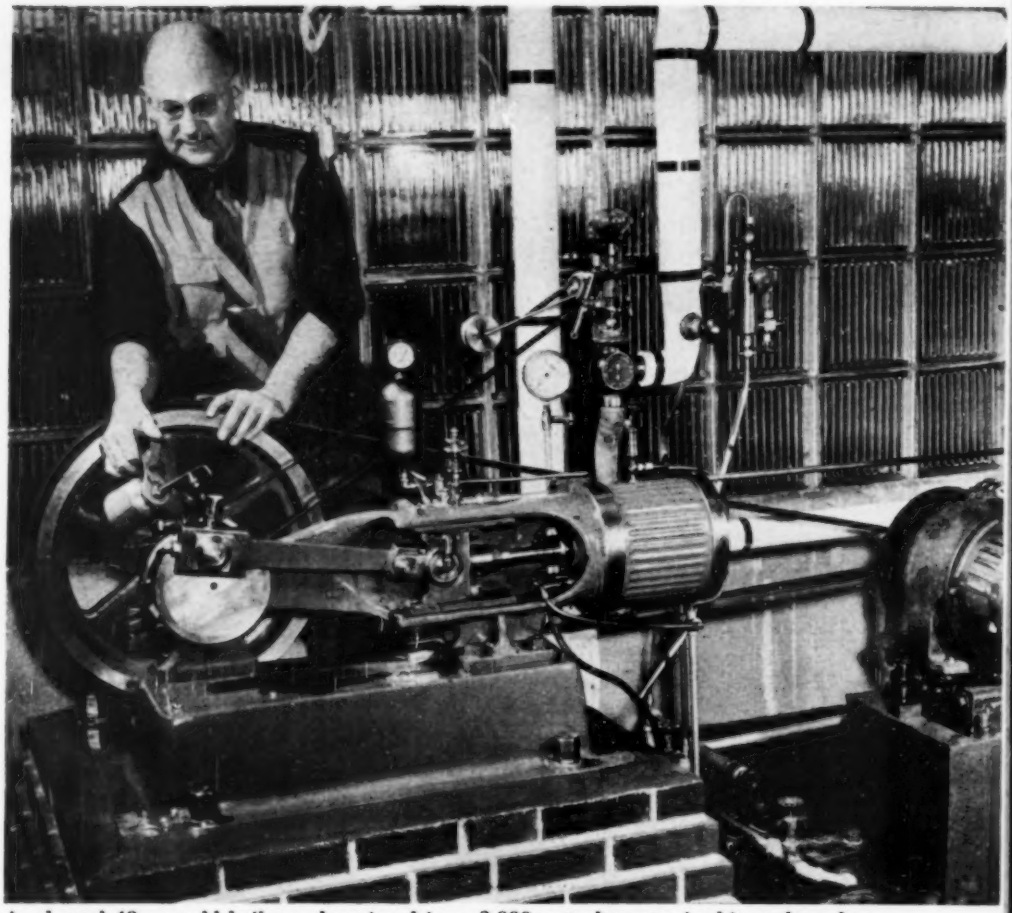
Midget Radios into Portables PAGE 203



Old bottles are the raw materials for making these man-sized mugs. Page 228.



A salvaged 40-year-old boiler and engine drive a 3,000-watt alternator in this modern shop.

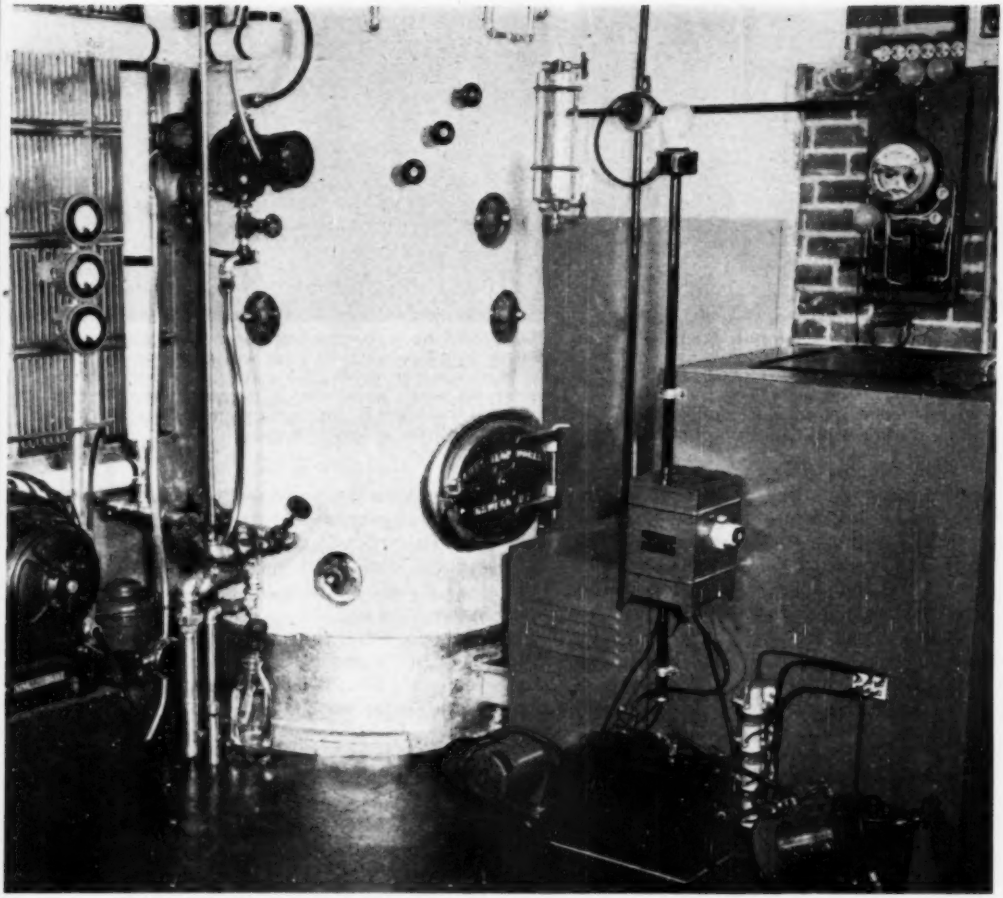
Steam Generating Plant

One of few Autogiro® pilots in country, Earle S. Eckel bases two of them on his private field.

By Harry Walton

PS photos by W. W. Morris

A RUSTING pile of scrap found in a junk yard two years ago is now driving a generator that feeds a home and workshop with all its electrical power. The scrap, rebuilt into a sweet-running steam engine by Earle S. Eckel, of Washington, N. J., does more than supply current for two good-sized



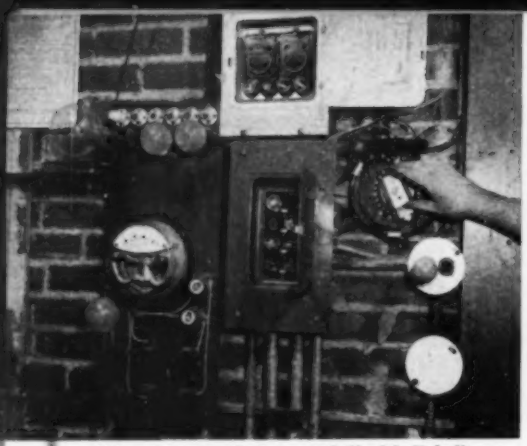
Boiler is stoker fed. In emergency, setup can be started by 6-volt battery in foreground.

Powers Home and Shop

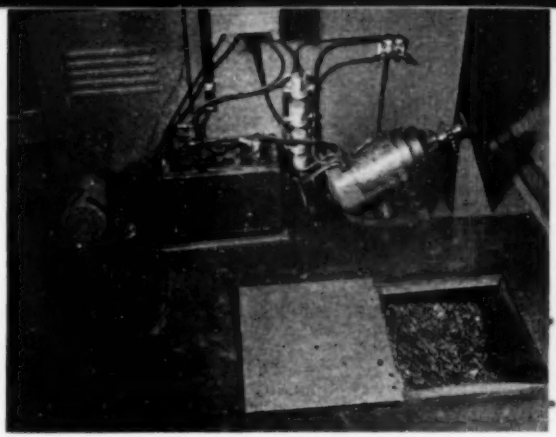
buildings. Its exhaust, piped through the floors, furnishes radiant heating at no extra cost to both shop and residence.

Things are arranged so that the plant can be started cold without outside power. A 6-volt stand-by battery drives a starting motor that can be connected to the boiler stoker. Once steam is up, Eckel can start the 5-hp., 5″ by 5″ single-cylinder engine. This drives a 3-kw. AC generator delivering 115 volts to all house and shop wiring. The 6-volt stoker motor is then cut out, the stoker continuing on 115 volts, as does everything else on the premises. There's a private electric meter to keep track of the power used.

Power-line juice is also available, and is normally used to check the frequency of the home product. Both currents are fed into a 220-volt bulb, which flashes irregularly as the steam plant comes up to speed. When



Electric meter brings no bill. It's Eckel's own. A 220-volt bulb near meter pulsates until generator is in step with standard 60-cycle power line. Then it goes out. Field rheostat, under hand, controls output of the 3,000-watt alternator that is driven by the steam engine.



Maintained by a charger just above it, 6-volt battery furnishes stand-by juice and also powers starter motor from 1914 car (right) that brings up coal. Knife switch triggers starter solenoids that close motor circuit. Small starter at left will drive stoker on 6 volts.

the alternator is putting out 60 cycles, the two phases cancel each other and the bulb goes out. Eckel then pulls a switch that shifts the entire load to his own plant. To run the alternator at the required 1,800 r.p.m., the engine lopes along at an easy 165.

A steam-power fan since the days he sold Stanley Steamers, Eckel bought the engine as junk for $35. It took him six months to recondition it. He had the cylinder rebored, fitted a new oversize piston himself, poured new bearings, replaced worn bronze valve and piston rods with stainless-steel ones, and rebuilt the eccentric. This he turned to a smaller diameter, and then fitted with an eccentric outer sleeve. By turning the sleeve he can adjust the valve stroke, and steam cutoff, for most efficient operation.

Worn crosshead guides were hand-scraped true. The original valve-rod crosshead, badly worn, was built up to size and chrome plated. A feed-water pump from a Stanley car is driven from the valve rod to keep a constant flow of preheated water going into the boiler. Its surge chamber is the body of an insecticide bomb. An electric auxiliary pump cuts in only occasionally to keep the boiler water level up.

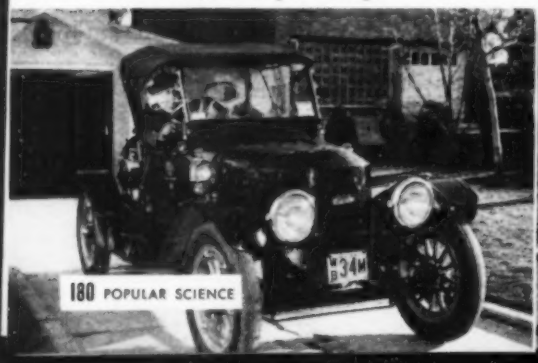
Undoubtedly better than new, the engine is also beautifully finished. Eckel applied eight coats of filler to all cast surfaces. Painted, they're as smooth as a 1949 convertible.

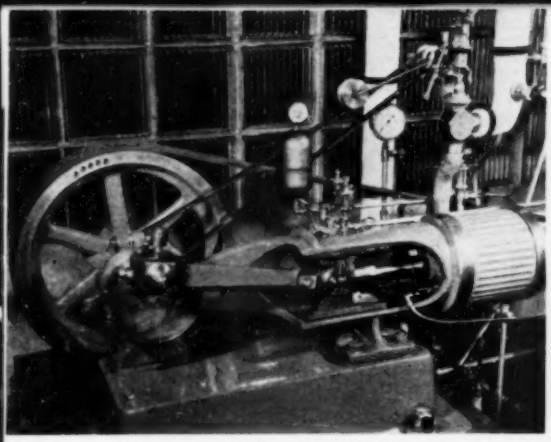
The 8-hp. vertical boiler is as old as the engine. He retubed it, installed an electric stoker and modern controls. Normal pressure is 80 lb. Coal, kept in a basement bin, is delivered to a floor trapdoor by a worm conveyor and shoveled by hand into the stoker hopper. Ashes are removed from outside.

Because stoker experts were doubtful about hauling coal up a 20-deg. slope, Eckel made his own conveyor. The trick, he reports, is to start the worm with a 2″ pitch,

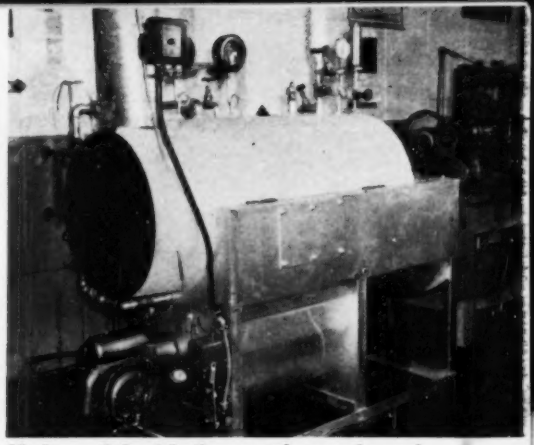
Old but like new, this 1914 noncondensing Stanley Steamer has rolled up more than 100,000 miles since 1917. Round fuel tank, like a bustle in the rear, holds mixture of gasoline and kerosene. Here, car has pressure up.

Insulated boiler gets steam up in 15 minutes from cold start, Eckel reports. Low pressure of 150 lb. will move car. Normal pressure is 500 lb. To withstand it, boiler shell is wrapped with piano wire. Thermocouples indicate water level.





Governor holds engine to 165 r.p.m. for 60-cycle frequency. Probably a humdrum gray 40 years ago, engine now glistens with smooth paint job. Bare metal is highly polished. Over-length piston has only 1/32" head clearance, requiring careful starting to avoid damage.



Modern oil-fired boiler can take over for coal-fired one. Ordinary furnace control is rigged to close damper when burner is off, preventing draft from cooling boiler. To avoid overloading generator, interlocking control lets only domestic water pump or oil burner run at one time.

increasing it to 3" at the top end. The worm shaft is a 12' length of 1½" extra-strong pipe. To this is welded a spiral of ½" by ½" square stock, with ½" round rod tack-welded to that. The 4" worm resulting runs in a casing of 4" pipe. It's chain-driven by a starter from a 1914 Overland, which conveniently has a 27-to-1 cycloid gear reduction built into one end bell.

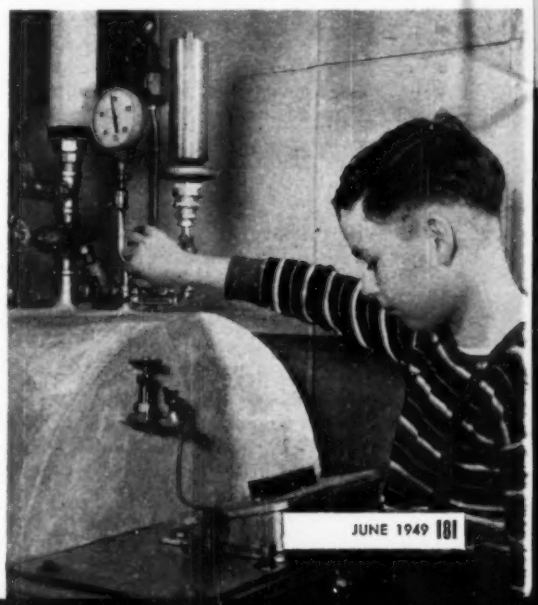
There's an auxiliary oil-fired boiler too. Its burner cuts in and out automatically, as in a home heating plant. Feeling that natural chimney draft wastefully drew heat from the boiler when the burner was off, the owner ingeniously rigged an ordinary furnace draft motor to a tight damper in the smokepipe. It closes the damper after the burner stops, opens it before the burner starts up again.

Old cars are another of Eckel's fascinating hobbies. In the same garage with his late Mercury sedan stands a 1914 Stanley on which he logs over 6,000 miles per year. An electric brougham serves for everyday shopping trips nearby. Both the old cars look like new. Three more Stanleys in his shop are undergoing meticulous reconstruction. The walls are placarded with photos and newspaper clippings concerning his own and other old cars.

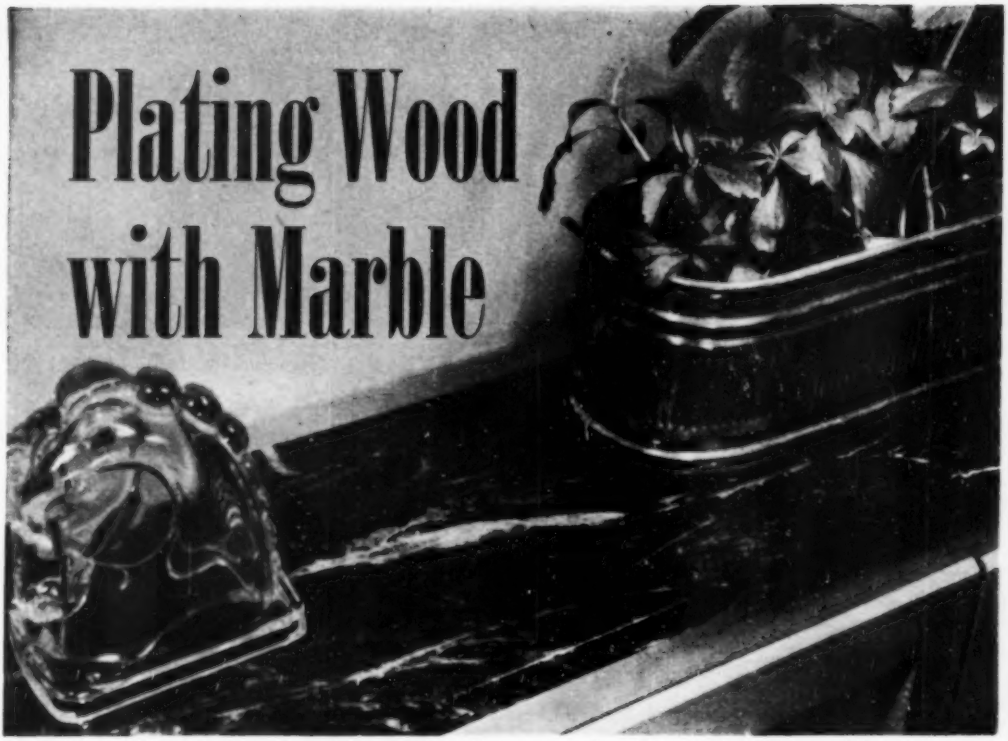
When highways are too slow, Eckel can take to the air. He's one of the few licensed Autogiro® pilots in the country, flying from a 50- by 300-yard landing field not far from his home. He has put 1,600 hours on the two Autogiros in his hangar, and frequently makes cross-country hops in them. Built in 1931 and 1933 respectively, both machines are licensed, airworthy craft.

Since his steam plant and Stanley roadster (which is one of the older, noncondensing types) require clean water, Eckel had a 20,000-gallon tank built into the foundation of his shop to store rain water piped from his roofs. Eventually, too, he'll get additional electric power from a stream running through his property. A good-sized water wheel is right now in the process of installation. END

Just for fun, steam whistle is connected to horizontal boiler. LeMont Evans, grandson of owner, is lucky junior engineer who toots it and runs tiny oscillating engine on smokebox.



Plating Wood with Marble



Realistic marble cabinet top is really a decal made from a color photograph of fine marble.

DECALS are back with a new twist—sparkling plastic veneers that can transform drab table tops into realistic marble surfaces.

They're easy to apply and inexpensive. A 34" by 50" sheet costs a little over $2; a slab of fine marble that size would cost at least 20 times as much. Any smooth surface—wood, glass, plastic, metal—will take these color-photo reproductions. Made by the Meyercord Co., of Chicago, the marble-type decals are called Sans-Marb® and the woodgrain patterns Sans-Arb®.

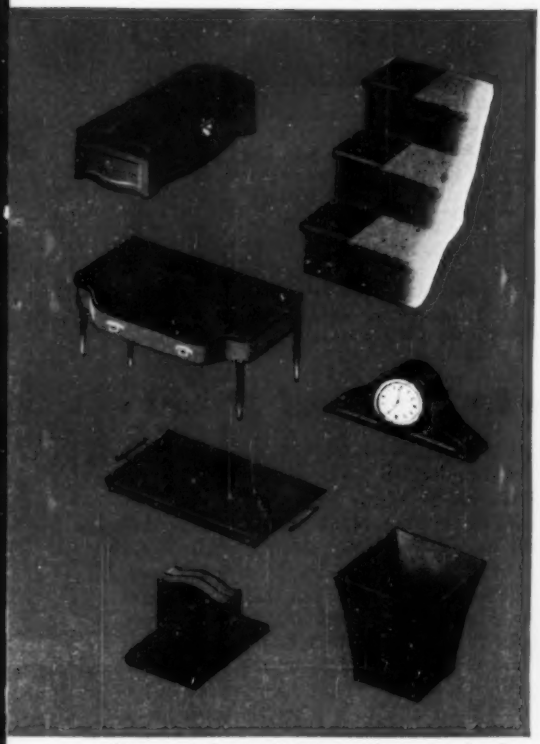
First thing to do is to prepare the surface you want to marbleize, if it's not already smooth. Since the film will draw down into the pores of the wood as it dries, open-grain woods require proper filling and surfacing. Otherwise, the pores will be visible on the plastic veneer. Undercoats, such as wood sealers and metal primers, should be sanded lightly before the veneer is applied.

Here's the way I treated a cabinet top that I marbleized. First I sanded it smooth. Then I brushed on a coat of varnish and let it dry 24 hours. This was followed by a light sanding. Next, the special glue—called 507-C cement by the manufacturer—was prepared. This is a clear liquid that you dilute half and half with water. The cement softens both the film and the surface varnish. As they are pressed together, they bond firmly, becoming a single thickness when dry.

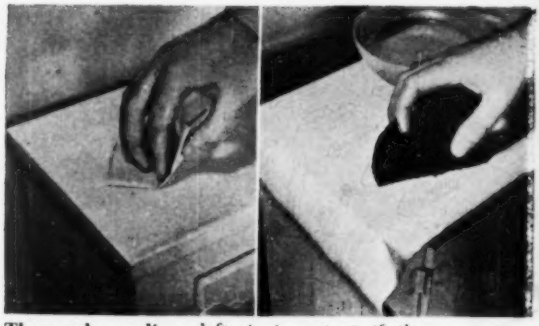
Before cutting the decal, hold it up to a strong light. You can see which way the grain runs. Then when you cut it to size, allow sufficient overlap to cover the sides of the top. This gives the finished work the appearance of a solid marble slab.

Use a sponge to spread cement evenly over the coated side of the decal. Then lay it down on the surface to be covered. If you have a rubber roller, press firmly and work from the center to the edges to iron out wrinkles and bubbles. A soft cloth will do as well as a roller.

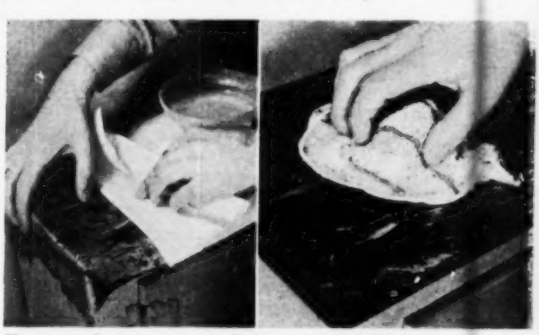
After you've smoothed out the top—not



Many articles in the home, from stair borders to clocks, may be covered with marbleized decals. In the case of stairs, protect the decal with a couple of coats of varnish.



Thorough sanding, left, is important if the surface is not already smooth. At right, the heavy paper backing is soaked before peeling it off. Back is ruled as guide in cutting.



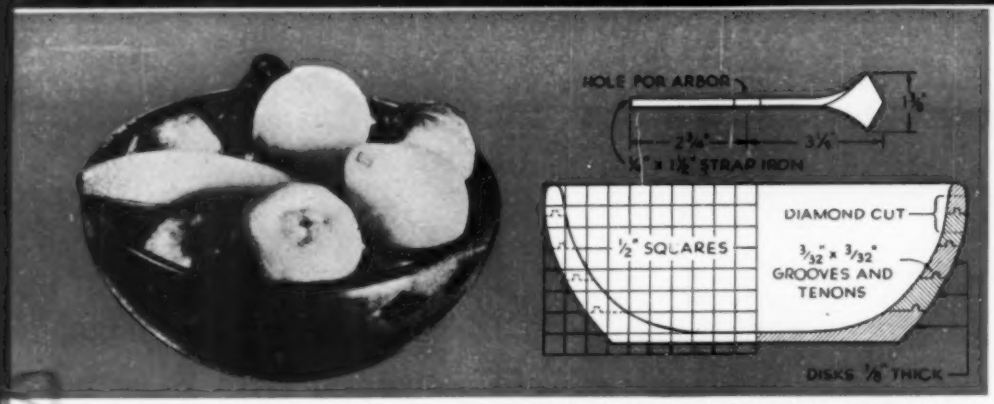
Remove heavy paper backing carefully to avoid pulling decal away from surface. Don't remove tissue paper under the backing. Right, wipe off tissue protecting decal with a wet cloth.

the sides—soak the paper backing with a wet sponge. Let the water soak into the paper for a few minutes. Then start peeling off the paper. Begin at a corner, separating the layer of paper and film. If the paper doesn't peel off easily, soak it with more water. This operation takes care. Otherwise the decal will pull off the surface, spoiling the job.

With a wet cloth, remove the tissue paper that protects the surface of the decal. Use the cloth to press out any wrinkles or bubbles you may have overlooked when removing the heavy paper. Turn the sides down, miter the corners with scissors, and trim off any excess along the edges. A razor blade is handy for edge trimming.

Let the work dry 24 hours and apply a coat of clear varnish. When the varnish has dried thoroughly, you can tone down the high gloss by rubbing with fine steel wool—*Arthur Miller, Manhattan, N. Y.*

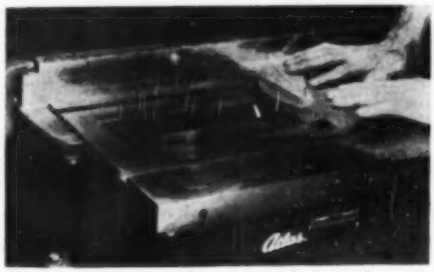
When work has dried thoroughly (24 hours) apply coat of clear varnish or lacquer. When dry, use steel wool to lessen the brilliance.



Five walnut disks are joined with grooves and tenons to form a blank for this turned fruit bowl. Diamond-shaped holes consist of V cuts made in top disks with the special tool above.

Diamond Holes Circle Turned Bowl

TURNED bowls are fairly familiar lathe projects, but this one is different. Diamond-shaped holes around the rim make the bowl stand out in any company. These are cut with the special tool shown above, facing V-cuts being made in two of the five disks from which the blank is built up.



Mount cutter on table-saw mandrel. Tack waste stock to the disk as guide while making cuts.

Disks are assembled and glued after cuts have been made. The V cuts should be about ½" deep.

Turn the bowl with a newly sharpened tool. Use waste stock on bottom disk to mount work.

Walnut is ideal stock. The beauty of building up the blank with disks is that you can utilize knotty stock if you're careful to lay out each disk so the edge is sound.

Grooves and tenons join the disks around the edges. Screw each of the four upper disks to the faceplate individually, turn a tenon or groove, and reverse it to turn the other. Be careful to get accurate fits. Glue the bottom disk to a piece of waste stock to eliminate screw holes.

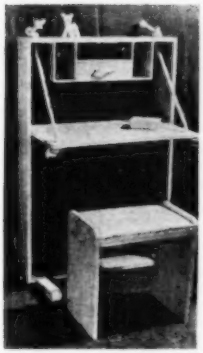
Lay out the V-cuts on the top disks with a protractor, spacing them evenly and leaving about ⅜" of the groove and tenon between. Mount the special cutter on the saw mandrel. Guide the disk into the cutter by tacking to it a piece of squared waste stock and setting the fence against the latter. This guide must be repositioned for each cut. A rectangular guide piece pivoted on the center of the disk may be best. Then, only the outer tack need be changed between cuts. Run in the cuts about ½".

Assemble all the disks and glue them together. When the glue has set thoroughly, mount the work in the lathe by the waste attached to the bottom disk. In turning the bowl, use a newly sharpened tool while shaping the pierced rim.

Sand thoroughly and give all surfaces a coat of thinned shellac, including the inside edges of the diamond cuts. Before the shellac has dried, hold an alcohol-dampened pad against the revolving surfaces to produce the final finish.

Remove the waste and cover the bottom of the bowl with a disk of felt or cardboard. *—Benj. Nielsen, Aurora, Neb.*

Rope Yourself a Desk

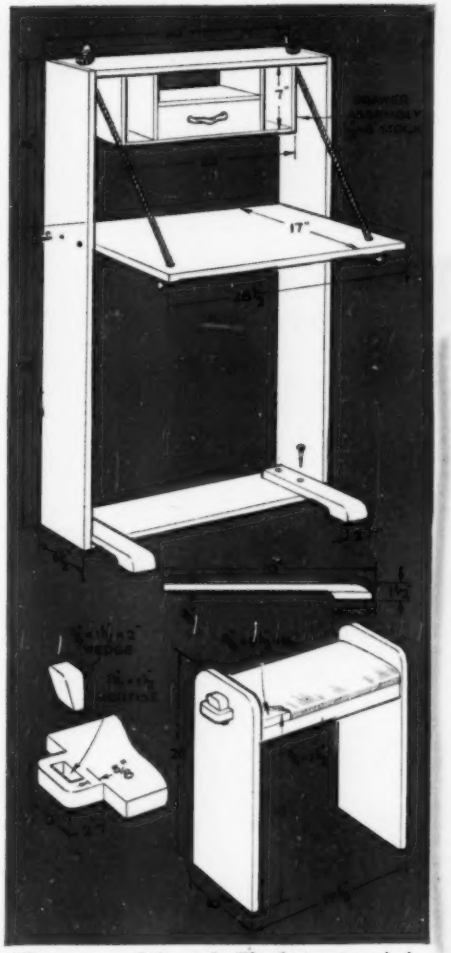


SIMPLE lines and simple construction mark this desk for a teen-ager's room. The lower part may be converted to a bookcase by removing the feet and writing board and installing shelves.

Use ¾" stock, cutting the pieces to the dimensions shown in the sketch at right. Drill slanted holes for the ¾" rope. Eight feet of rope should be enough with a small piece left over. Separate a strand of this waste and use it as a drawer pull. Fill in the countersunk screwheads with composition wood or putty and sand smooth. Give it your favorite finish.

You can introduce color into the set by covering the seat of the bench with artificial leather or denim. Don't depend on the wedge joints alone to hold the bench rigid; run screws from the aprons to the seat and from the sides to the aprons.

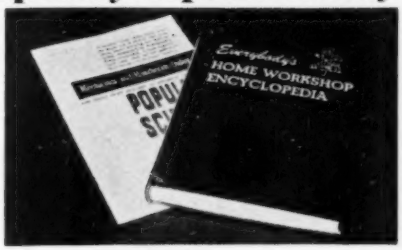
As shown in the photo and drawing, the writing board is held stationary by three screws through each side. By pivoting it at the front of the sides, the leaf could be built to fold up into the desk.—*Ysobel Boynton, La Jolla, Calif.*



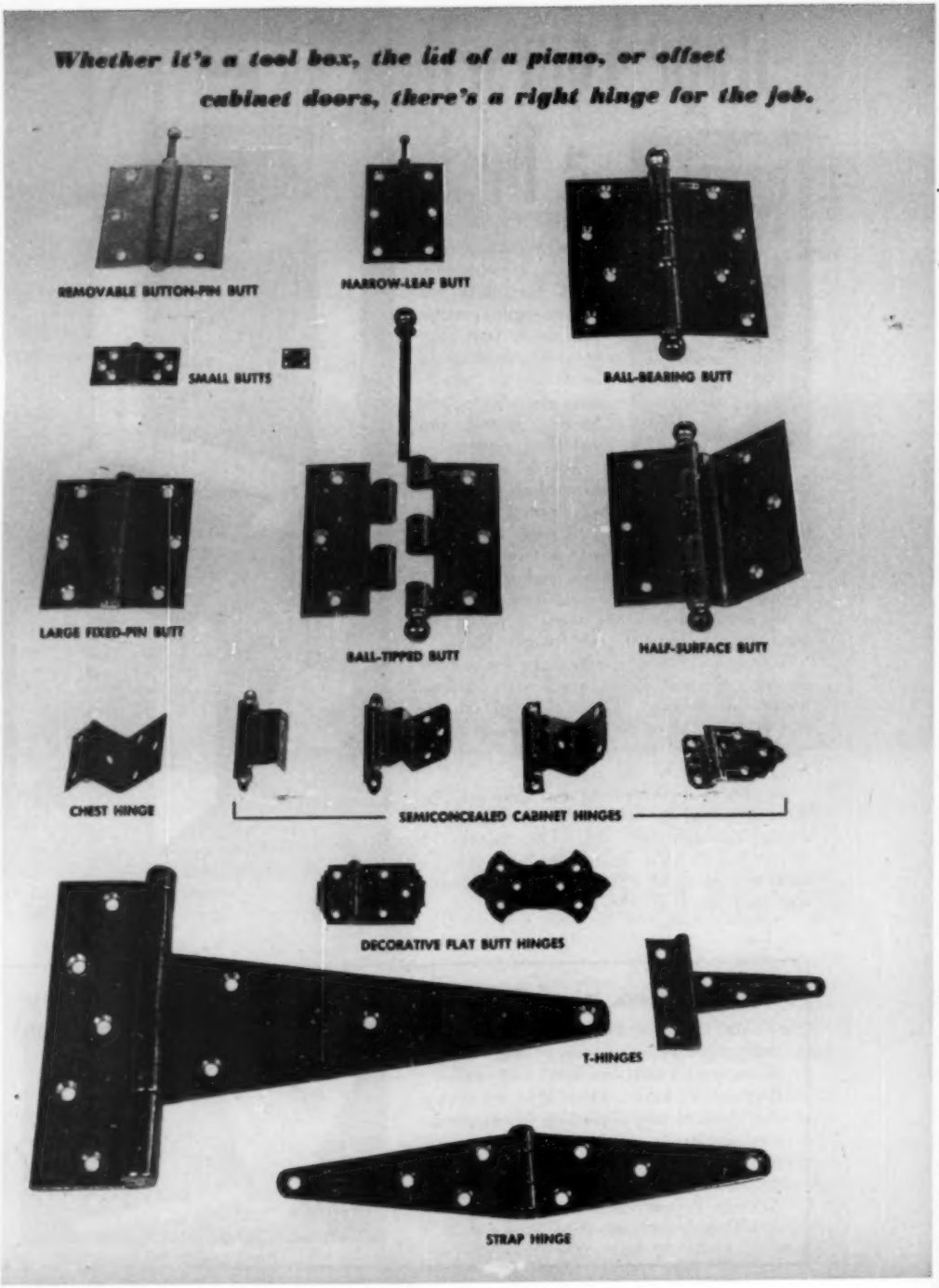
All parts are ¾" stock. The feet are made by gluing up two ¾" pieces for proper thickness.

New Index and Workshop Encyclopedia Ready

THE 1948 PS Mechanics and Handicraft index is available at 10 cents a copy, as are copies only for 1947, '43, and '41. If you don't have a file of PS back copies, the latest Home Workshop Encyclopedia contains many articles published in past issues. The regular edition is $2.98; in a de luxe gold-lettered binding it's $3.48. Address Popular Science Publishing Co., 353 Fourth Avenue, New York 10, N. Y.



Whether it's a tool box, the lid of a piano, or offset cabinet doors, there's a right hinge for the job.



Know Your Hinges

By Roland Cueva

WHEN you step into a hardware store, do you say,

"Gimme a couple of hinges," or, "A pair of 3″ by 3″ loose-pin butts?"

It may make the difference between a project you're proud of and one that doesn't quite come off. Essentially, a hinge is just a gadget that lets you bend wood around a corner without breaking it. But there's always the right one for the right spot.

Butt hinges—used more than any other type—come either swaged or flat. The leaves of a swaged hinge are mortised into the wood members. Consequently, the leaves are depressed slightly from the knuckles so they come together when the hinge is closed. The leaves of a flat hinge form a straight line when open, the knuckles all projecting on one side. A flat hinge is used for full-surface application.

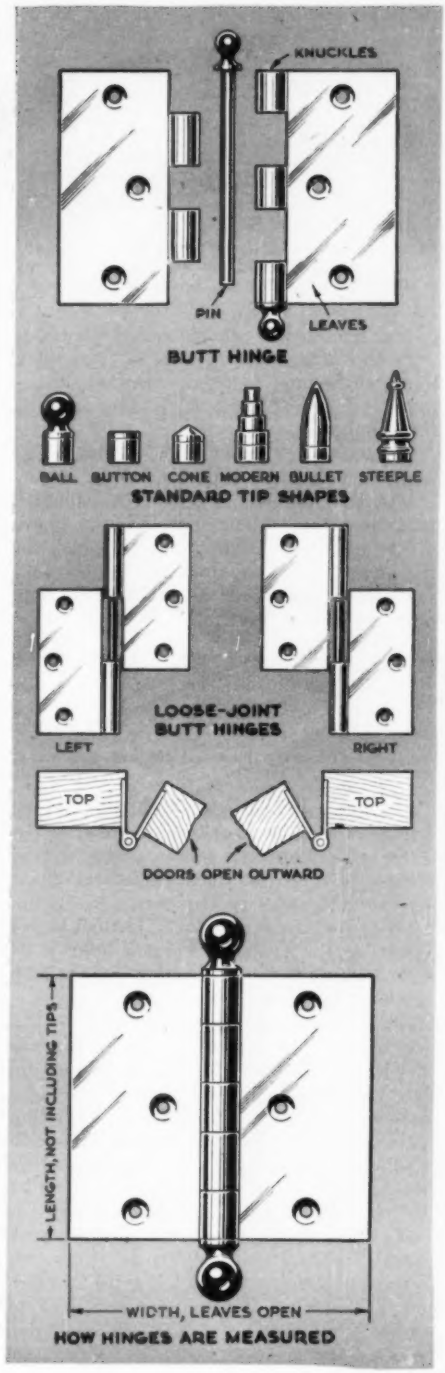
Besides the ordinary rectangular butt hinge, here are some variations:

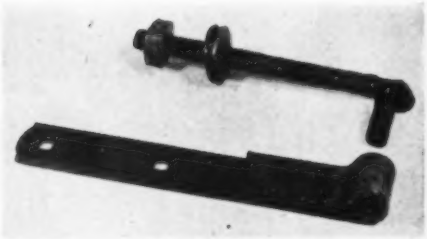
Loose-joint butts. These have only one knuckle on each leaf. There's a fixed pin in the bottom one so they may be separated by lifting off the top section. They're available in right- and left-hand assemblies for such uses as casement windows and cabinet doors.

Half-surface butts. Used when you want one leaf mortised into the jamb and the other flush on the door surface.

Semiconcealed cabinet hinges. These are made for both flush and lipped doors. The swinging leaf is bent to fasten to both the edge and inside surface of the door.

Offset cabinet hinges. Made for lipped





Pivot hinge. This is a bolt-and-strap hinge. You'll see them used on heavy gates, farm buildings, and sometimes on garage doors.

doors. Each leaf is attached on the outside.

Double-acting butts. This is a complex hinge engineered to operate in both directions. You'll find them on folding screens, for example.

Continuous or piano butts. A long strip hinge that may be cut to the desired length.

The U. S. Bureau of Standards estimates that the entrance door of the average home opens and closes 15,000 times a year. So the importance of adequate hinging is obvious. This table gives recommended hinge sizes for various doors.

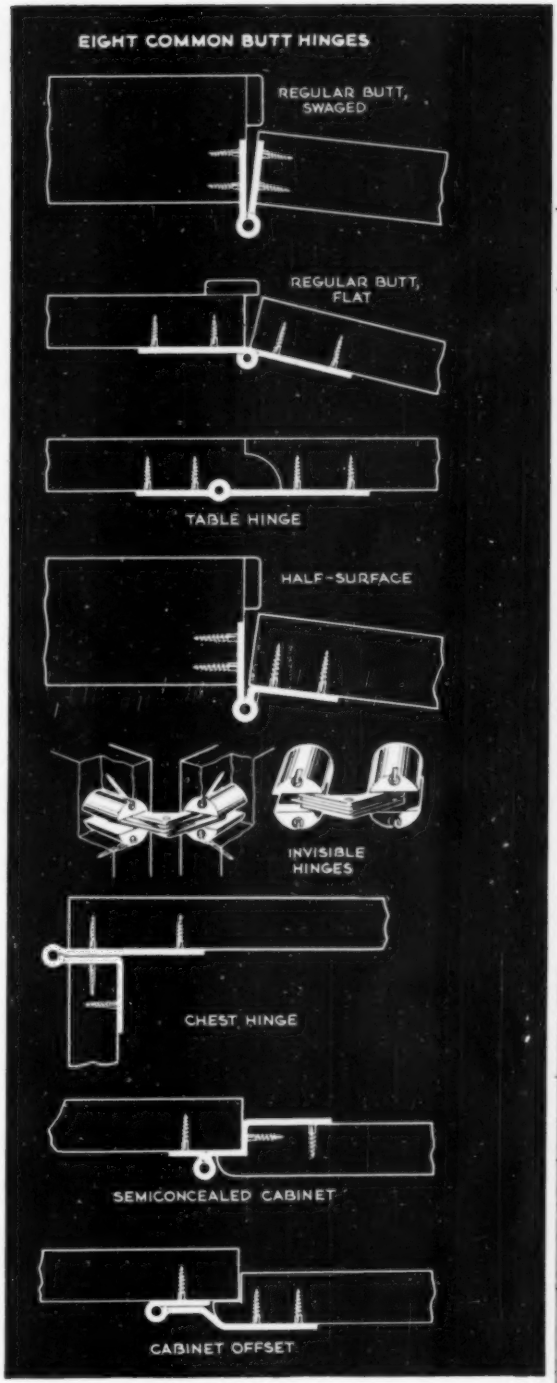
DOOR THICKNESS	DOOR WIDTH	HINGE HEIGHT
¾" to 1⅛"	up to 24"	2½"
⅞" to 1⅛"	up to 36"	3"
1⅜"	up to 32"	3"
1⅜"	32" to 37"	4"
1¾"	up to 37"	5"
2" to 2½"	up to 43"	6"

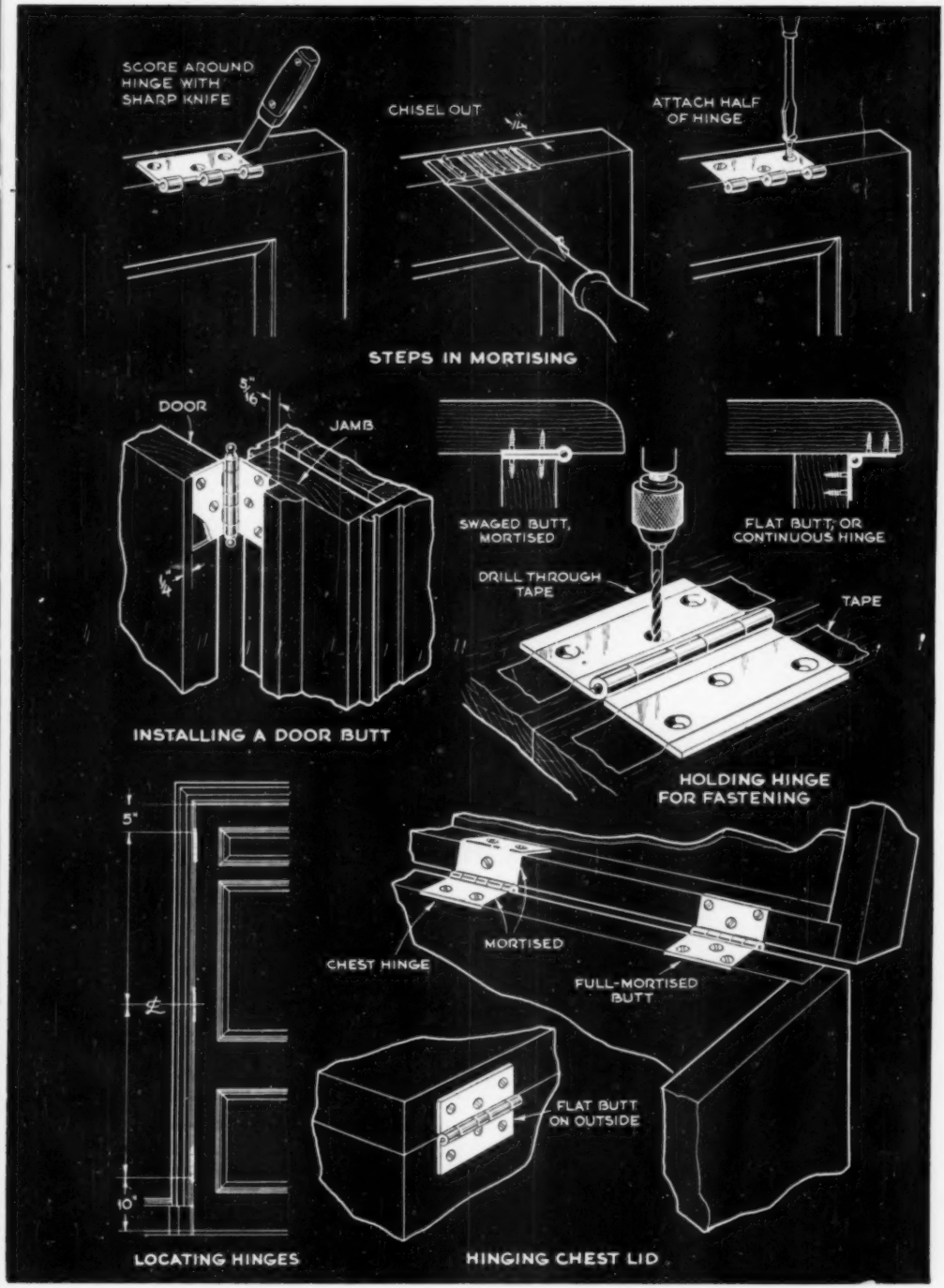
Doors larger than 2½" thick and 43" wide take heavy-duty, ball-bearing butts.

All hinge dimensions above refer to the length of the joint, not to the spread of the leaves. To figure the proper width of butt hinges, double the thickness of the door, add the thickness of the trim, and deduct ½" for doors up to 2¼" thick. Deduct ¾" for doors up to 3" thick. For example, a 2" door with no trim would require a butt with a leaf spread of 3½".

Pivot hinges (that's one pictured at the top of this column) have a much more restricted use than butts. You'll find them on heavy gates, the doors of farm buildings, and sometimes on garage doors. The strap part of these hinges has a loop at the end that swings on the pivot. Shutter hinges are similar, except the straps are offset to let the shutter swing flush with the casing.

For fancy jobs, you can use decorative hinge straps. These are dummy plates that fasten over the mortised leaves of a standard butt hinge. They give the effect of an ordinary hinge. You'll frequently find them on massive entrance doors. END

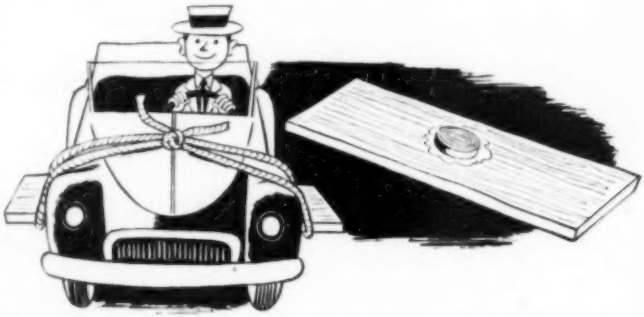



SCORE AROUND HINGE WITH SHARP KNIFE
CHISEL OUT
ATTACH HALF OF HINGE
STEPS IN MORTISING
DOOR
JAMB
5/16"
SWAGED BUTT, MORTISED
FLAT BUTT, OR CONTINUOUS HINGE
DRILL THROUGH TAPE
TAPE
INSTALLING A DOOR BUTT
HOLDING HINGE FOR FASTENING
5"
℄
10"
MORTISED
CHEST HINGE
FULL-MORTISED BUTT
FLAT BUTT ON OUTSIDE
LOCATING HINGES
HINGING CHEST LID

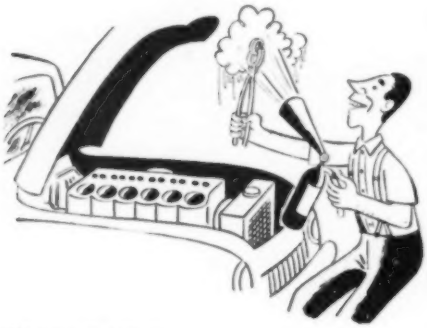
What's Your Ingenuity Quotient?

Even hanging by my toes. I can drive nails where I want 'em. I stick the nail on the magnetized end of a ¼" drill rod, slip the rod in a brass ⅜" pipe, and hammer the other end.—*M. P. Schuler, Milwaukee.*

Trying to bend copper tubing without proper tools usually winds up with something looking like a batch of leftover macaroni—collapsed and full of kinks. At least, that was my experience until I tried this trick. I didn't have a set of bending springs but I did have a step pulley. Using the step that corresponded to the radius I wanted, I just bent the tubing around the pulley.—*A. G. Werschky, Bay City, Mich.*



I was driving through a field 22 miles from town when a rock knocked the drain plug off the crankcase. A friendly camper offered me a supply of lube if I could find a substitute for the broken plug. I folded a rag into a pad, covered it with rubber cement, and laid it in the center of a 2' board. With the board under the engine so the pad covered the hole, I pushed it up tightly with a jack. Then I wired the board to the engine block and drove back to town. Very little oil was lost.—*Joseph Singerman, Manhattan, N. Y.*



Deep freezing helped me install valve-seat inserts. Instead of heating the block in the area of the seats, I used a carbon-dioxide fire extinguisher to cool and shrink the inserts.—*J .E. La Hue, Hermiston, Ore.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.

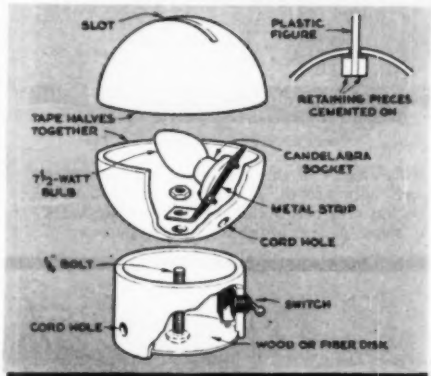
Plastic Night-Lights the Nursery

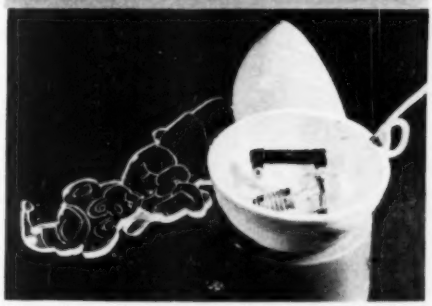
CHEERED by the soft glow from this teddy-bear light, most youngsters will drop off to sleep readily. And even though it's left burning the night through, it won't play tricks with your electric bill, for plastics have a way with light. A small bulb feeds its illumination into the bottom edge of the cutout figure. The clear acrylic plastic pipes it through to its outer edges, and also spills a portion of it from every scratched line in the surface. The nursery figure was designed with special regard for its light-spilling qualities by Nadine Walton, of White Plains, N. Y.

For this size lamp a 5″ by 7″ piece of ¼″ clear plastic is needed. Enlarge the squared drawing, jigsaw the outline, and scribe the internal markings with a hand grinder or vibrating engraver. Polish the bottom edge only; the others should be smoothed and frosted with sandpaper. You can give the figure an added fillip by heating and twisting the peak of the cap and the candle flame.

A plastic rattle or bath ball 4″ in diameter can be used for the base. It is sawed in half and the top slotted to receive the figure. The two halves are held together with decorative cellulose tape of a contrasting color. For the stand, a part of a plastic cylinder came in handy. A rabbet was turned in the lower part and it was fitted with a wooden disk as shown in the drawing. Any square or cylindrical section could be used in place of this. If it is solid, turn out a cavity for the bottom of the ball.

A 115-volt radio pilot-light bulb or night light is amply bright. The photo shows a good dodge. A 650-ohm, 10-watt wire-wound resistor is wired in series with a 7½-watt bulb. It doesn't reduce light output much, but it does cut down the current. This keeps the base cooler and increases bulb life.—*R. Gorman, Manhattan, N. Y.*

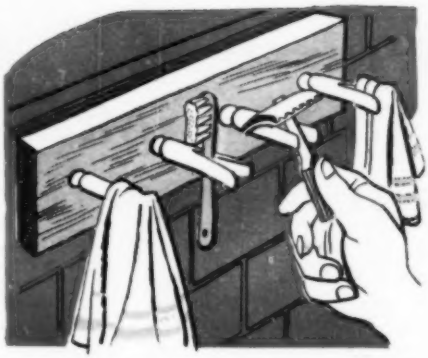




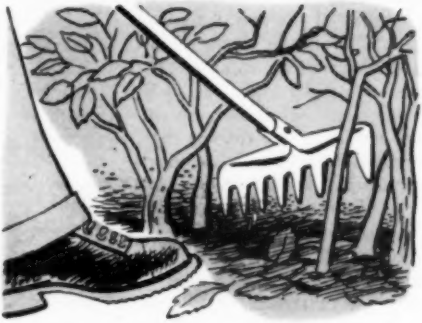
The clear plastic figure lights up only along its frosted edges and scribed lines; the base, made of a baby's rattle, spreads light evenly.

Keeping the Home Shipshape

Lawn chairs of the type shown can be given more elbowroom by adding a concealed, pivoted arm below the regular one. Recesses—or holes—in the lower arm hold glasses.



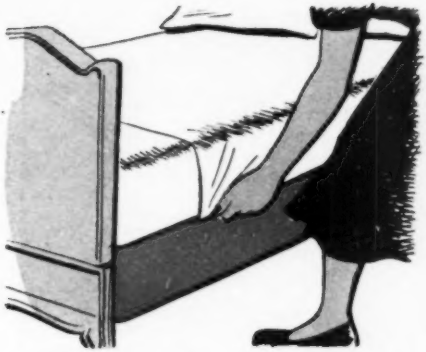
A bath rack for the country cottage may be improvised from any length of wood and a few clothespins. It's best to drill the wood for the heads, although glue and nails may serve.



A child's toy rake, fitted with a longer handle, makes a fine special-duty garden tool. It gets under hedges and into narrow corners where regulation rakes can't be used.

There's no need to stoop to pick up threads or other small bits from the floor or rug. Do it with a stick by fastening any kind of gummed tape—sticky side out—to one end.

When you take down curtain rods, towel racks, and similar fixtures for moving, tape all loose hardware to the large pieces. It will be handy for putting them up in your new home.



Greater foot freedom can be obtained by folding a 3" tuck in the top sheet when making up a bed. The tuck, near the foot, allows toes to stretch without pulling out the sheet.

A short piece of rubber hose or tubing slipped over the tip of a kitchen faucet as shown lessens the danger of breaking or chipping glasses when they are washed or filled.

Tie a knot in clothes that are badly soiled or stained before putting them in the hamper. The knots will serve as reminders to give these items special attention on washday.

Powder puffs that have outlived their usefulness in the boudoir are still good for cleaning silver and glassware, polishing shoes, and the like. Save them in a wide-mouthed jar.

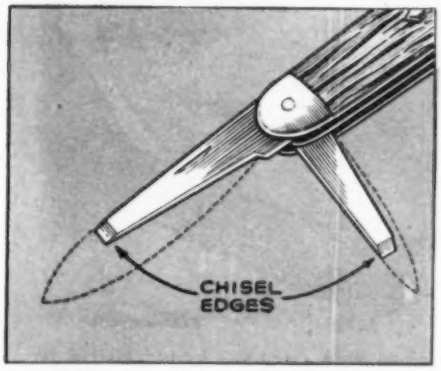
Slip a curtain rod across the top of a three-panel folding screen when you need extra space for hanging coats. The screen can easily be folded out of the way when your guests leave.

Pedals Drive Rowboat

THE Aquacycle®, manufactured by Aquacycle Co., Inc., of Covington, Ky., fits standard rowboats and leaves both hands free for handling rod and reel. Pedals turn a shaft that drives a propeller to move the boat. Clamps, similar to those on outboard motors, hold the Aquacycle to the transom. Shifting the weight of the body from side to side steers the boat.

Plastic Boat Inflates

LOW cost and light weight are two features of these inflatable Vinylite® boats manufactured by Bilnor Corp., New York City. The one pictured above is 72" long, weighs 5 lb. inflated, and is priced at $25. A smaller model, 56" long, weighs 2 lb. and costs $10. The larger boat has four separate air chambers in the sides and a level, inflated bottom.

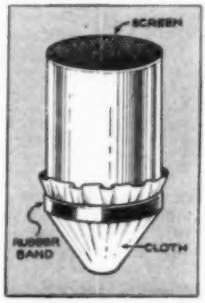


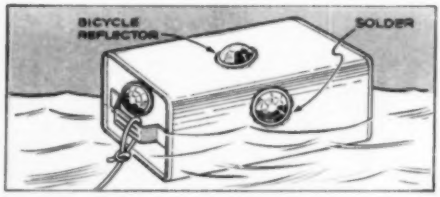
Old Blades Make Chisels

AN OLD pocket knife may be given a new lease on life by grinding the blades to form small chisels. The tools are especially helpful in model building. If used with a straight thrust, the blades will not fold.—*Victor H. Lamoy, Upper Jay, N. Y.*

Outboard Funnel Has Filter

I MADE this funnel for my outboard from a large beer can—the kind with a neck. Cut the bottom out and solder a piece of fine-mesh screen in its place. A piece of cloth held around the neck by a rubber band finishes it.—*Lea Schultz, Jacksonville.*



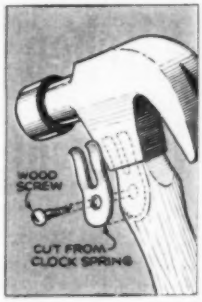


Reflectors Spot Float

LIGHT from your boat will show up buoys or floats if you solder glass-jewel reflectors to them. This is also a good trick for trotline floats: boats passing at night aren't so apt to snag them. Clip the screw off the reflector and solder the glass holder to the float. Use regular bicycle reflectors.—*Arthur Trauffer, Council Bluffs, Ia.*

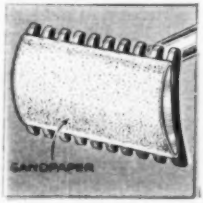
Clip Starts Nail in High Spot

It's easier to start nails in overhead areas if you install a clip on your hammer as shown here. Slip the nail head under the clip, turn the hammer sideways, and start the nail with one blow. Then slide off the hammer and finish the job.



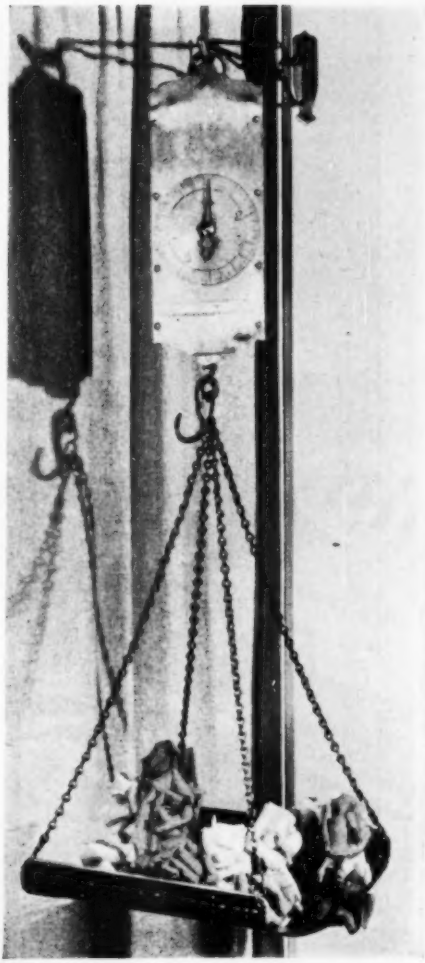
Razor Sands Curved Surfaces

For sanding small work, especially if it has curved surfaces, a safety razor makes an excellent holding tool for the sandpaper. Simply tuck the edges of a small rectangular piece of sandpaper between the head and comb of the razor and tighten the handle in the usual way.—*Charles Moffett, Jr., Lawrence, Kan.*



Twins Ride in Double-Decker

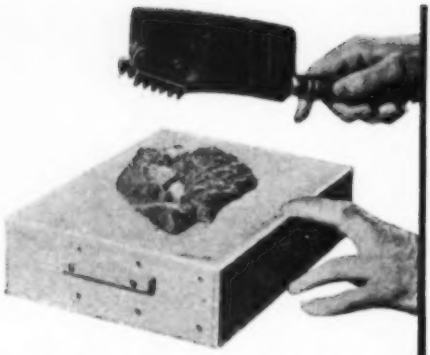
Taking their twins for an airing no longer is a problem for Mr. and Mrs. H. W. Jones, Springfield, Ill. Fabric seats are slung between crosspieces on the tubular-steel frame of the two-level stroller Papa built.



Old Brass Scale Holds Flowers

Years ago this old scale was weighing farm produce. Today it is an unusual conversation piece in a living room. Its pan makes a fine spot for displaying flowers, fruit, ivy, or seasonal decorations.

The brass face was shined with steel wool and given a coat of tarnish-preventing clear lacquer. The hand, hook, and suspension ring were lacquered bright red. Chains and pan were enameled black. Gold paint was used to highlight the chain links and pan edges, and to put a simple design on the pan sides. A bird-cage bracket acts as a mounting.—*Walter E. Burton, Akron, Ohio.*

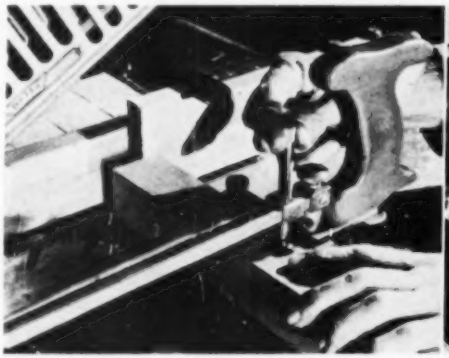


Finished chopping block is fine base for pounding meat or cutting vegetables. Construction is similar to a butcher's table—built up of pieces bolted and glued together.

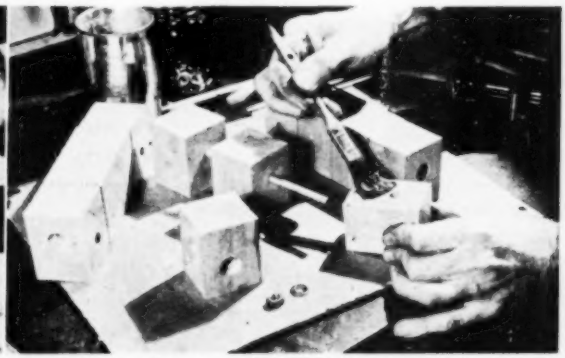
Kitchen Chopping Block of Maple

ASSEMBLED with bolts and glue, 20 pieces of maple form a rugged kitchen chopping block. It's useful for tenderizing meat, cracking bones, and chopping vegetables.

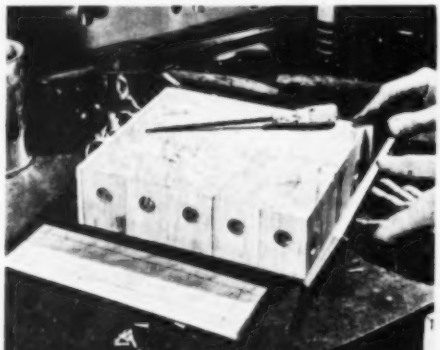
The step-by-step photos show the construction of a 4¾-lb. block that measures 2¼"



1. Here 1¾" by 1¾" maple is sawed into 20 2¼" lengths. Note stop clamped to fence. This gives clearance between fence and block to prevent jamming when cut is nearly through.



2. Nontoxic glue is applied to sides as each four-block unit is assembled on a ¼" by 6¾" bolt. Use jig to position blocks for drilling or clamp several together and bore them.

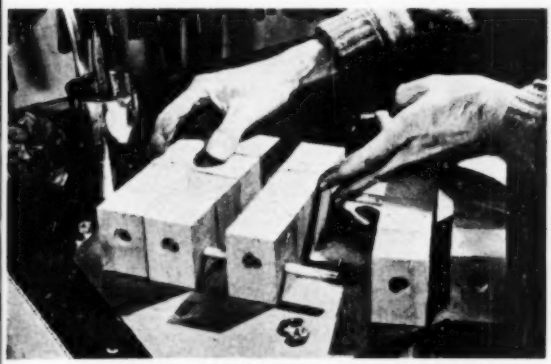


4. Sides of assembled block are covered with strips of maple about 3/16" thick. Held by countersunk wood screws, these cover bolt holes. They may be removed to tighten bolts.

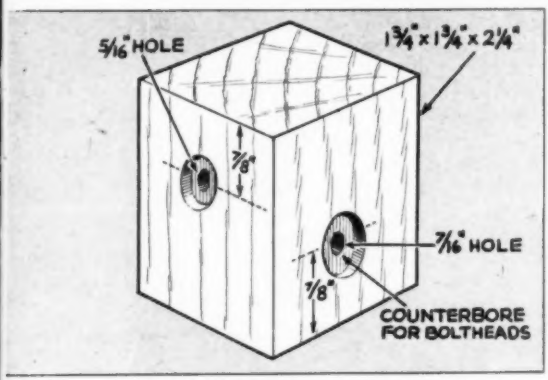
5. After sanding chopping surface and sides, paraffin is applied to top. Bottom is covered with sheet cork or leather that acts as cushion. Small maple handles are screwed to ends.

by 7¼" by 9⅝". Maple is one of the best woods to use since it is dense grained and hard. The chopping surface is formed of end grain.

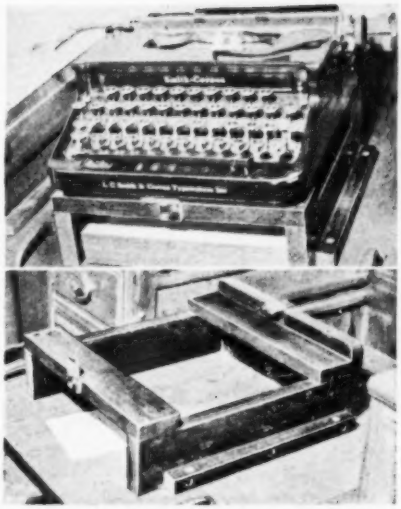
After you've cut out the pieces and assembled the block, the chopping surface should be impregnated with paraffin. I used a 250-watt infrared lamp to heat the wood so the wax would penetrate it. You can also warm the wood with an electric or gas heater, but be careful not to scorch it. When the wood is warm, paint the melted wax on with a brush or swab. After it has cooled, scrape off any excess with a putty knife. The paraffin coating discourages the penetration of meat or vegetable juices, and yet has no effect on the taste of meat or vegetables.—*Walter E. Burton, Akron, O.*



3. Four-block units then are glued and assembled on two ¾" by 8½" bolts, one through each outer five-block row. Holes in each outside block are counterbored to sink boltheads and nuts.



This gives you dimensions and hole locations. If socket wrench is not available to engage nuts in recessed holes, slot heads so screwdriver can be used to turn them.



Base Raises Portable

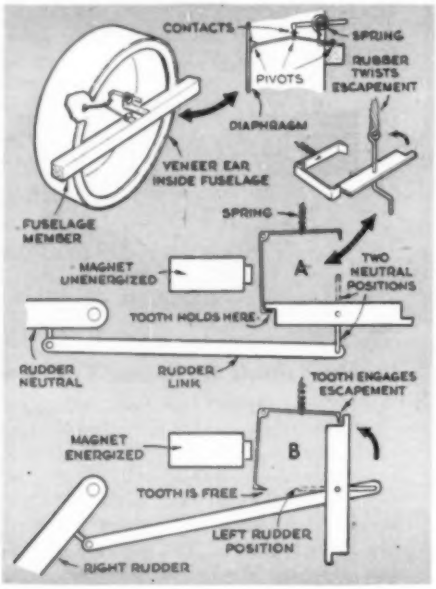
PORTABLE typewriters can't be used on most desks with typewriter wells. The machine sits so low that the carriage would strike the sides of the well as it is moved from side to side. To get around this, I built the simple base shown in the photos above. It raises the portable so the carriage will clear the sides of the well. The base was assembled of ¾" stock and held to the desk leaf by screws. The typewriter may be bolted to the base or held in place by metal clips.—*John M. Avery, Dexter, N. Y.*

Hand Truck Rolls on Tracks

THE base of this hand truck, rolling on caterpillar treads, pivots to conform to the pitch of stairs or curbs. It also locks in a closed position for rolling on level surfaces. Other features include expansion-type brakes and concave crossbars for handling round objects. The maker is American Machine Works, Inc., Racine, Wis.

Sonic-Control Glider Obeys Your Voice

ONCE this glider is up, your voice is your control line. Just yell, and the rudder flips over to change direction. The new sonic control, developed by A-J Aircraft Co., Portland, Ore., takes remote piloting of models out of the licensed radio bands. The unit will be available in a 36″ glider late this year for about $25.



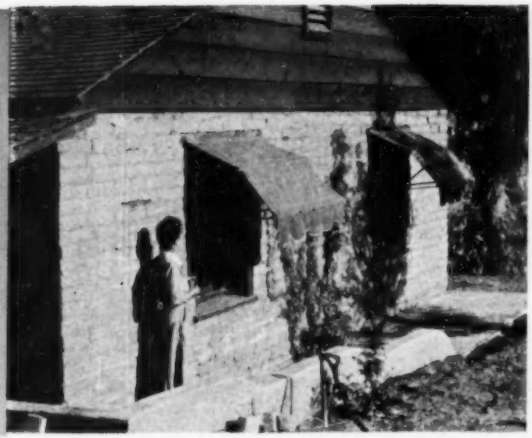
Challenging pilots to find thermals and keep gliders up by skillful maneuvering, the sonic control opens a new contest field. With no signal, the ship shown flies in a circle. Time your shouts properly, and you can make it fly in turns, figure eights, and spirals. Its sound-sensitive "ear," tuned to a pitch of about 256 cycles (middle C on the piano) is said to respond to shouts within 100′ and to a horn up to 400′. Muscle power for the rudder is provided by rubber bands working a magnetic escapement, which is triggered by two midget flashlight cells.

The glider's ear is a diaphragm of thin veneer. A linkage pivoted to it carries a contact point. Held against this by a hairspring is another pivoted contact. The circuit is normally closed, holding the escapement at right or left rudder. A sound impulse vibrates the diaphragm contact away from the other, opening the circuit.

A sustained sound leaves the magnet unenergized, and the bell-crank spring pulls out the tooth near the magnet to hold the escapement latch in one of two neutral positions (A in the drawings). When no sound signal vibrates the diaphragm, the contacts stay closed, the toothed bell crank is drawn to the magnet, and its other tooth engages the latch as at B, giving left or right rudder.

A short note breaks the circuit only for an instant, the latch being released for a full half turn and caught again as at B to give opposite rudder.

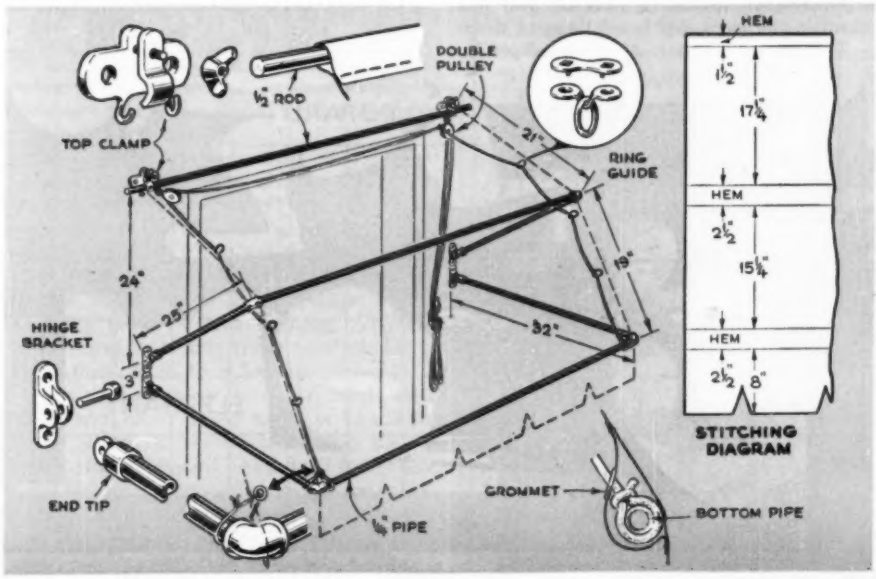
Buggy-Top Awnings for Your Casement Windows



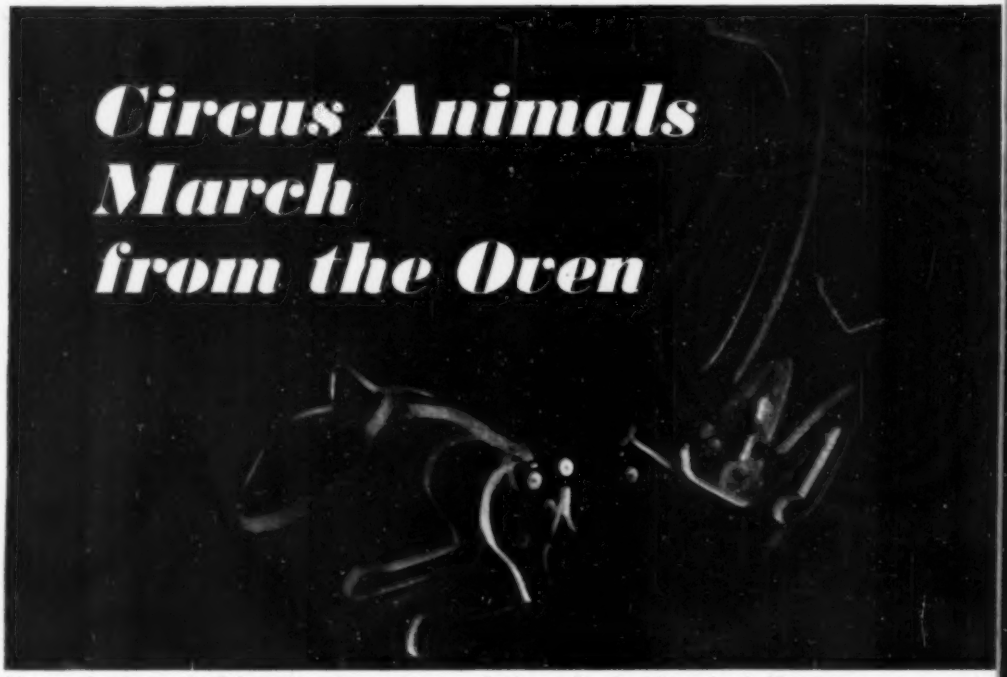
BESIDES adding comfort and a pleasant bit of color to your home, you'll find these homemade awnings a considerable saving over ready-made ones. They're easy to put up and take down, and they're especially suited for casement windows that swing outward. The hip gives ample clearance without requiring a frame mounted high over the window, as is usually necessary with conventional casement-window awnings.

Fittings can be bought at a hardware store. I used ¼" galvanized pipe with the end tips hinged in brackets screwed to the wall. Hems are sewn in the fabric as indicated in the stitching diagram. After the pipes and ½" rod are inserted in the hems, the arms are screwed in place.

To keep the fabric taut from side to side, the edges are wired to the arms through grommets. Sash cord, or clothesline of good quality, is tied to each end of the lower pipe and carried through the grommets and pulleys. Use a double pulley on the side of the awning where the pull cord hangs down. A cleat, screwed to the window frame or wall, holds the cord.—*Hi Sibley, Nuevo, Calif.*



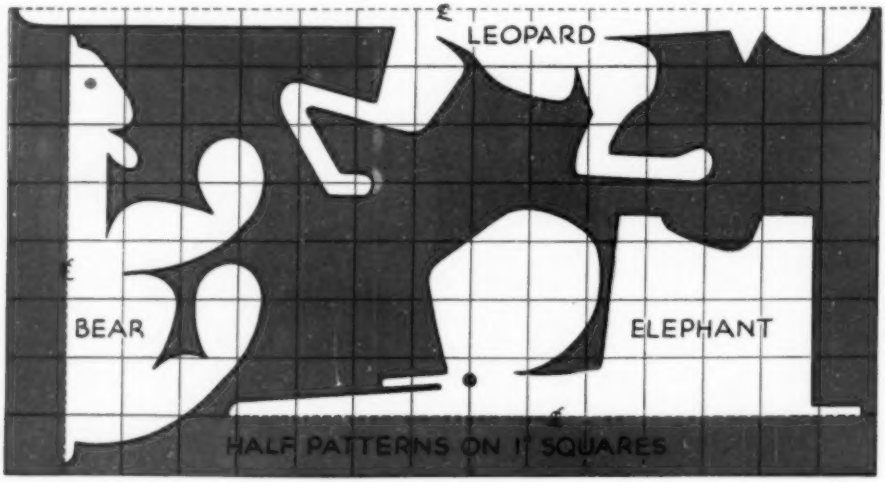
Circus Animals March from the Oven

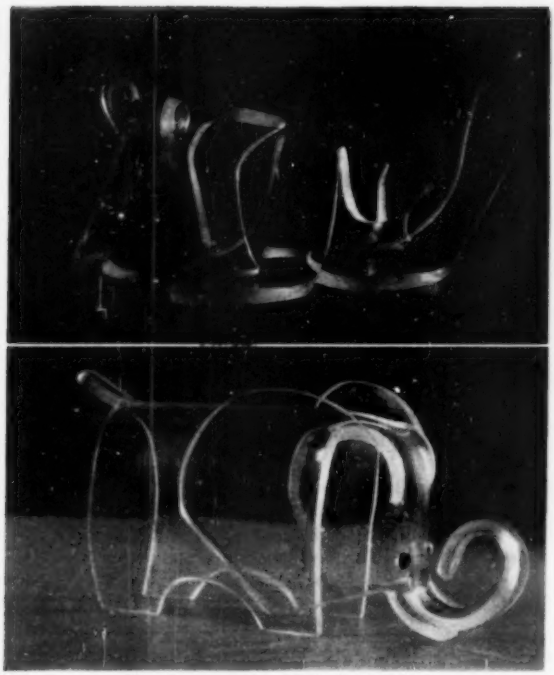


This is the leopard. Like other figures, it was laid out by doubling the half patterns.

THESE plastic beasts—added attractions on any knickknack shelf—start life flat on their backs. They're simply forms sawed from a 3/16" sheet of plastic. You heat them in the oven and bend them to shape.

Use an acrylic such as Plexiglas® or Lucite®. Lay out one of the patterns shown below or, if you're handy at the drawing board, design your own animal. Transfer your selection to the masking paper on the plastic. Then cut to the outline with a jeweler's saw or jigsaw. File the edges





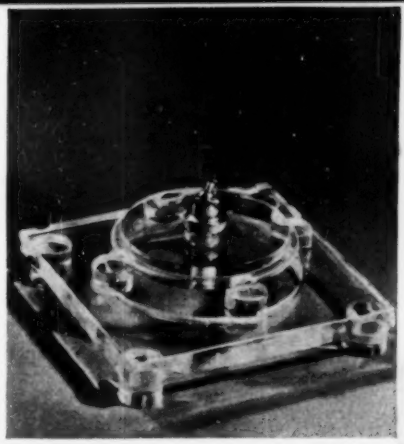
Plastic bear, top, and elephant are nice gifts.

smooth, rounding the bear's paws, the elephant's trunk and ears, and the leopard's long tail. Drill holes for the eyes.

On edges that are too close together for filing, use folded strips of fine emery cloth. Some edges, too, will be more accessible after the figure is bent to final shape. In any case, the edges should be smoothed but not polished.

To form the animals, strip off the masking paper and lay the plastic on a clean, flat surface in a hot oven, 275 deg. F. When it's pliable, remove it with gloved hands and bend the body. That, and the tail, is probably all you'll have time to do before the plastic cools and rehardens. Shape the remaining parts by local heating. You can dunk them in boiling water until pliable or hold them close to a heating element.

In that way, curve the necks, heads, ears, tails, and such. Insert tacks or beads for eyes. Sequins, cemented to the plastic, complete the leopard. And don't forget that nice feature of thermoplastics: if you're dissatisfied with the finished pose, put the whole business back in the oven and start over.—*Doris Aller, San Francisco, Calif.*

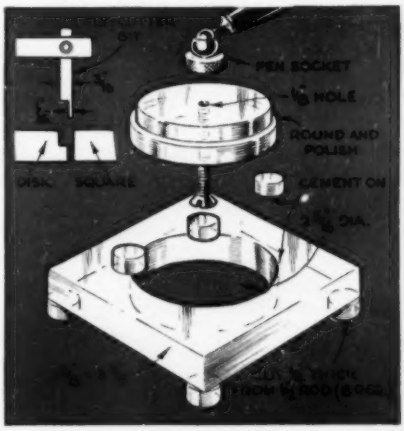


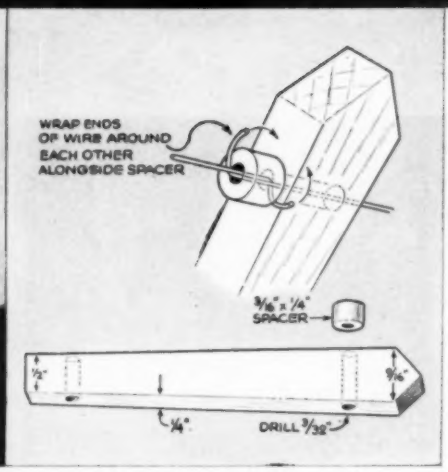
Pen Stand Cut from Plastic

THIS gleaming desk stand for a fountain pen can be turned out in one evening. It's a low-cost project, too. All you need in the way of material is a square of ¼" or 5/16" plastic and a short piece of ½" plastic rod. You can buy the pen socket at a stationery store, or perhaps lift it from an old desk set.

Square up the base and find the center with diagonals. Cut out the disk with a jigsaw or a fly cutter. If the latter, grind the bit so it'll leave a rabbet on the disk. Then round the edge of the disk and polish it. It also may be necessary to clean up the hole in the base with fine sandpaper, especially if you sawed out the disk.

Next saw off eight ¼" sections of the ½" rod. Sand these smooth and polish them. Cement four of these pieces to the base as legs and the other four, overhanging the hole, as supports for the disk that holds the pen socket.—*M. J. Moch, Jamaica, N. Y.*



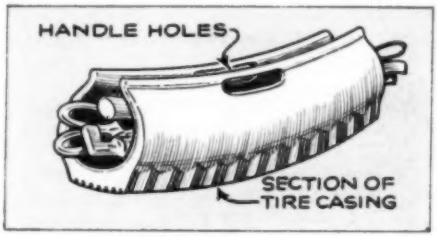


Miniature Picket Fence Encloses Flowerpot

THOSE drab little red flowerpots can be dressed up as decorative additions to a window sill or shelf. Just encircle the pot with a picket fence. Cut pickets from scrap, long enough to suit the height of the pot, and sufficient in number to fit closely around its bottom diameter. (I used 27 pieces in the one shown here.) A jigsaw makes fast work of the taper, or you can shape ripsawed strips on a power sander. Make the spacers from ¼" dowel, drilled lengthwise and then sawed into 3/16" lengths, or by slicing sections off thick-walled rubber tubing. Assemble with wire, inserting a spacer between each picket at the top. Fasten wire ends as shown. Paint the fence to suit. This one has white pickets and red spacers.—*Dick Hutchinson, El Monte, Calif.*

Tool Holder Cut from Tire

A SECTION of old tire casing, cut as shown in the drawing, provides a handy carrier for an assortment of wrenches and other small tools. The handles are simply elongated holes cut near the bead with a sharp knife. A piece of casing 12" to 15" long will hold a surprisingly large number of tools.—*Victor H. Lamoy, Upper Jay, N. Y.*

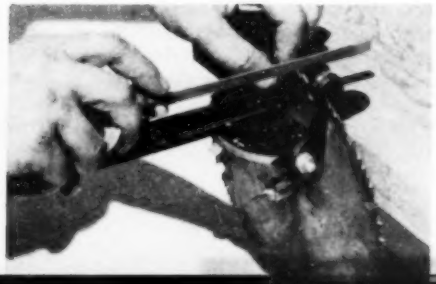


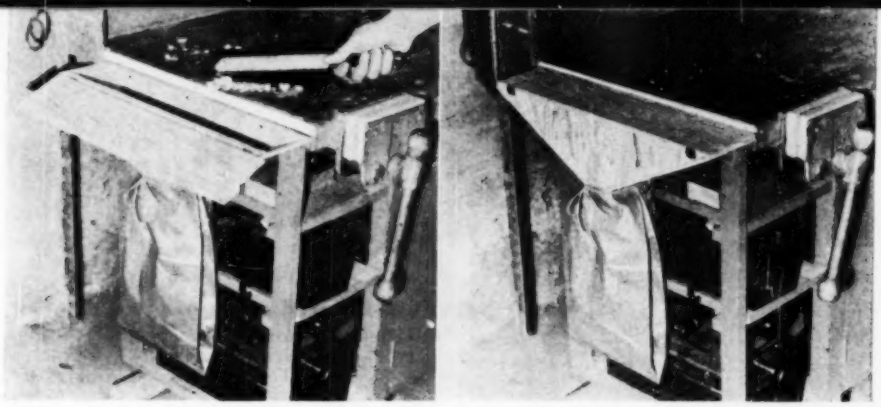
Swabs Help Clean Guns

COTTON-TIPPED swabs—the kind used with babies—ease the job of cleaning and oiling hard-to-get-at places on revolvers and rifles. They also may be used to touch up small worn spots with gun-bluing solution.—*Capt. W. A. Van Sandt, United States Army.*

Gadget Sharpens Table Saws

ONLY two adjustments are necessary to sharpen most home workshop circular-saw blades with Sure-Sharp®. Four interchangeable mandrels handle blades with ½", ⅝", ¾" and 13/16" centers. Calibrations on the file holder give correct and uniform pitch, and the guide arm is adjusted to the correct angle and held by a single wing nut. The file is fixed in the holder by a setscrew. It's priced about $7 by the Sure-Sharp Manufacturing Co., of Santa Ana, Calif.



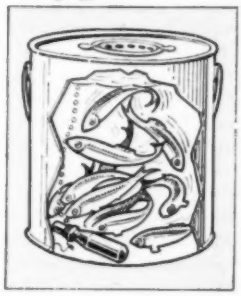


Workbench Hopper Gathers Litter into Paper Bag

AFTER you've finished a job, the top of a workbench is usually cluttered with sawdust, scraps, and miscellaneous debris. The hopper above takes care of that problem.

Its convenience is evident from the photos. When you're through, just turn back the hinged top and brush the debris into the hopper. A paper bag tied to the bottom collects it. When the bag is full, empty it or put on another. The top of the hopper is about ½" below the level of the bench.—*Arthur H. Smith, Hawthorne, N. Y.*

Oxygen Cartridge Keeps Minnows Alive in Pail

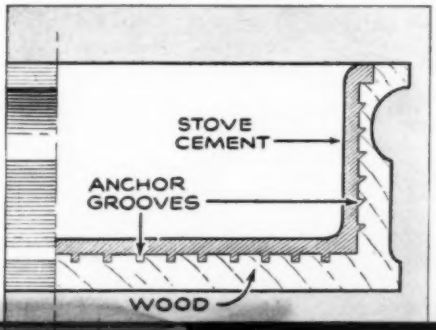


FISHERMEN change water frequently in bait pails to keep minnows alive, but Occo Products Co., Minneapolis, Minn., claims its new Min-O-Air® makes this task unnecessary. Priced at $2, it consists of a valve unit and three cartridges of compressed oxygen. When a cartridge is connected to the valve unit, as seen at right, a twist of the valve releases oxygen. One cartridge is said to keep a dozen minnows alive for 24 hours.

Stove Cement Lines Ash Trays

ASH trays turned from wood or plastic can be lined with stove cement. This solves the problem of finding a glass liner to fit, or turning the tray to suit one on hand.

Cut anchor grooves inside the tray. With a smooth paddle, apply a coating of cement about 1/16" thick. Rough-finish at a very slow lathe speed. When thoroughly dry, smooth with emery cloth and steel wool. If your cement is the water-thinned type, use caution while washing or it may soften.



Plastic Sight Gives Full View

WHEN you equip a shotgun with a new rear sight made by Speedsite, Inc., of Grand Rapids, Mich., you have all the advantages of a peep sight—plus the ability to see the full target area simultaneously. It consists of a block of clear plastic encased in a metal clip. A hole drilled through the plastic serves as the peep sight.

How Power

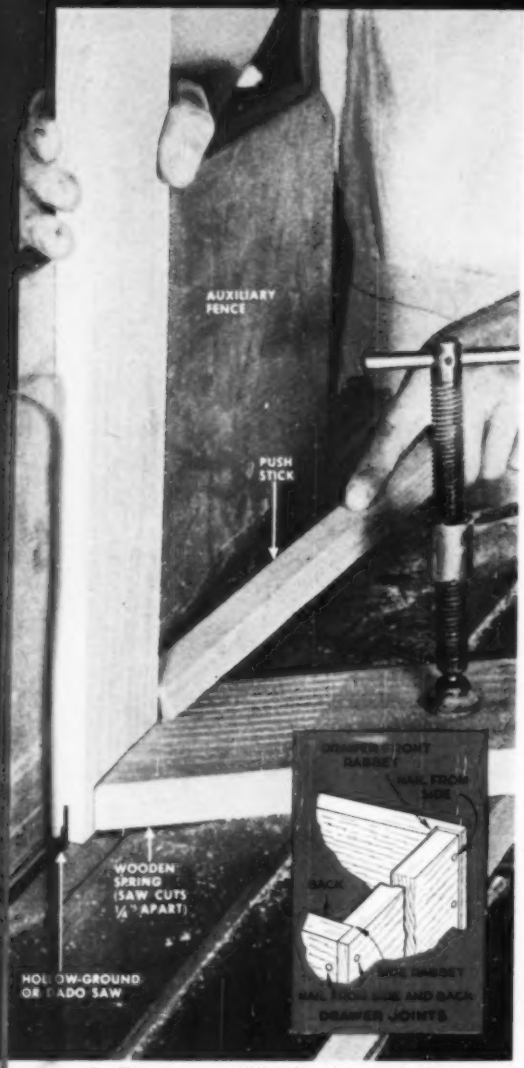
Tight-fitting box corners need well-cut rabbets and miters. Power tools make accuracy almost automatic.

By Edwin M. Love

MAYBE there's no easy road to success, but there certainly are shortcuts. Power tools are the woodworker's road to speed and accuracy. You don't have to train your fist for the struggle with rebellious hand cutters when a fence or gauge can guide work past moving blades more accurately than the most practiced hand. And because they take so much of the sweat and labor out of woodcrafting, power tools enable you to try construction that would be impractical—if not impossible—by hand. Locking joints used in assembling drawers and chests are good examples.

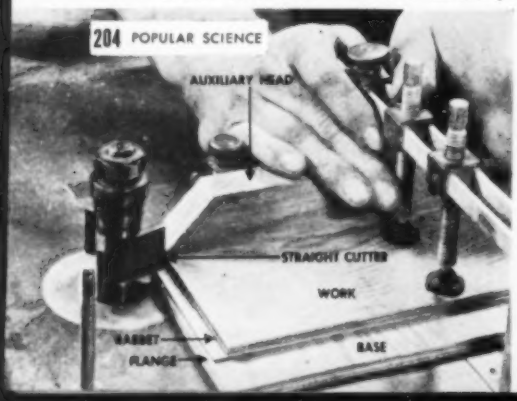
Regardless of whether they're made with hand or power tools, rabbets and miters form the basis of box corners. In constructing drawers for cabinets, carpenters generally use rabbets in the assembly shown in the inset of Fig. 1. Although they have no locking effect in themselves, such joints stand constant service. The rear ones, being nailed from sides and back, almost never separate; the front ones may tend to loosen but can easily be nailed again.

Deeply rabbeted box joints are almost as neat as the mitered variety, since the rabbet flanges veneer the ends of the butting sides. The setup shown in Fig. 1 is excellent for

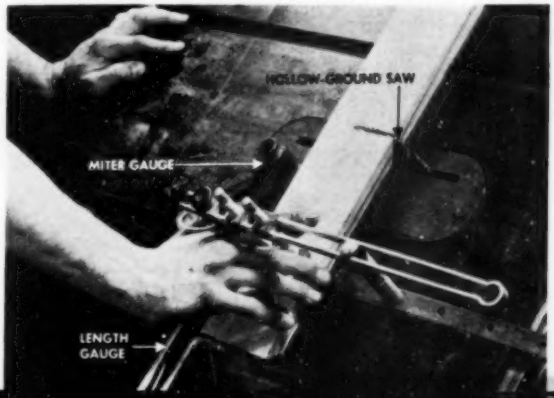


1. Ripping a rabbet by this method protects the flange. Inset shows a conventional but serviceable construction for drawer corners.

2. Shapers cut rabbets in a single operation. Make the rabbet a little longer than finished size so it can be sanded flush after assembly.



3. End miters can be made quickly with a combination blade on a circular saw. Tilt the table or arbor 45 deg. Use hold-down clamps.



Tools Make Box Joints

ripping any rabbet, especially as it protects a thin flange from damage. While the cheek is cut, the piece is supported by a high auxiliary fence against which it is pressed with a wooden spring. Saw the shoulder in the usual way, guiding the work with a miter gauge.

Even better than the circular saw is the shaper, which completes a rabbet in one pass. In Fig. 2 the outside face of the work is shown resting on a stiffening board. An auxiliary head screwed to the miter gauge prevents splitting as the cutter emerges. After rabbeting one side, turn the piece end-for-end to cut the other. A length gauge (shown in Fig. 3) should be set to catch the shoulder of the first rabbet.

An ordinary combination blade on a circular saw is good for cutting rough end-miters. Tilt the table or arbor 45 deg. The hold-down clamp pictured in Fig. 3 prevents creeping. If you don't have this type of clamp you can use an auxiliary head on the miter gauge and drive a few small points through the face to grip the work. Test all setups on scrap before taking cuts on the work. Faulty miters are easily corrected with a sanding disk or belt, but here again the setting must be accurate.

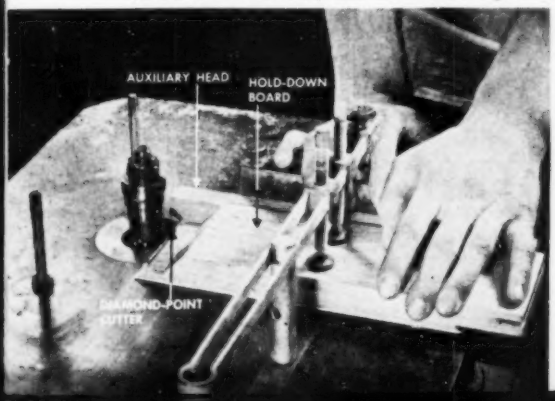
Stock that isn't over ½" in thickness can be readily mitered with a diamond-shaped cutter mounted on a shaper. Accuracy is sure because of the precision grinding of the knives. It's essential that the work be held down snugly on the table as in Fig. 4. A straight cutter on a drill press will do the job too. Tilt the table by removing the locking pin underneath it and loosening the swivel nut. Groove a board to receive the bar of the miter gauge and bolt the board to the drill table. To get a longer stroke, reverse the gauge from its usual position. The setup is shown in Fig. 5.

A tongue-and-rabbet joint that locks from one direction is shown in Fig. 6. It's the kind you would use on the front of a heavy-duty drawer, since the locking action resists any tendency of the front to pull away from the sides. There's another advantage in this type of joint in that it offers a lot of gluing area. On the other hand, you have to allow for the tendency of the cross-grained projection to split off.

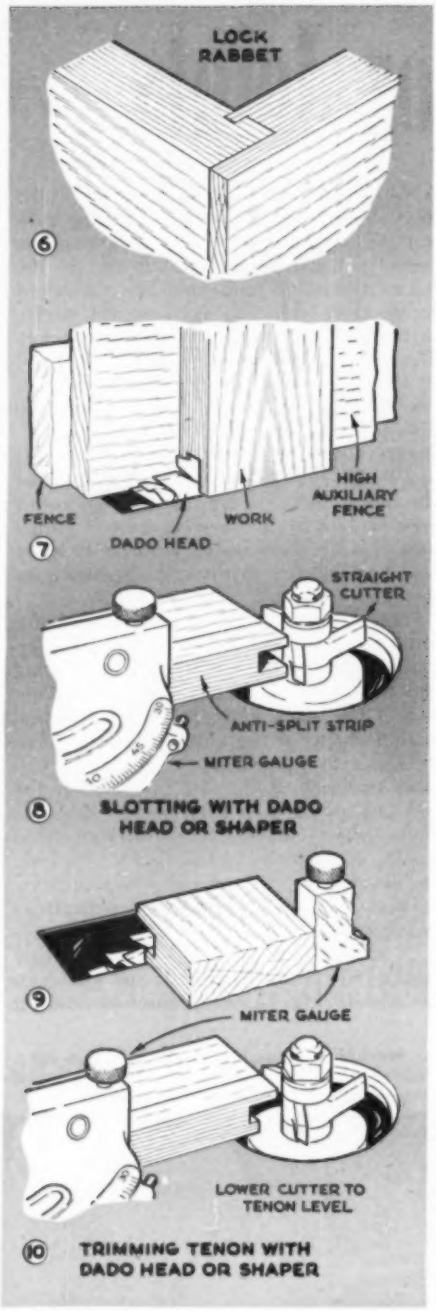
The drawings show several methods for cutting lock rabbets on various tools. In Fig. 7 the technique illustrated calls for slotting the end of the front member with a dado head. The same job can be accomplished with a shaper if the cutter is long enough to reach to proper depth (Fig. 8). Cut back one wall of the slot by either of the methods pictured in Figs. 9 or 10, using a dado head or shaper. It's possible to speed up the construction of lock joints by setting the saw for one operation and the shaper for another. The drill press also is satisfactory when used as a shaper.

A modification of the lock rabbet that uses a mitered corner to hide end grain can be seen in Fig. 11. Procedures for making

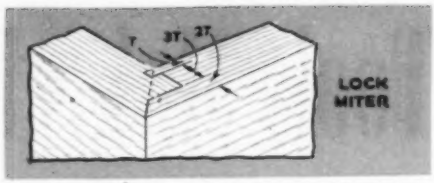
4. Thin stock can be mitered on a shaper with a diamond-shaped cutter. The work rests on the table; it's held flat by a board and clamps.



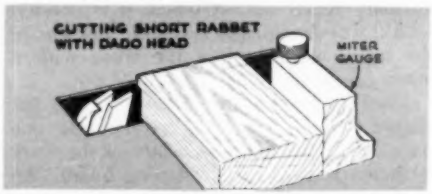
5. Straight cutters, used shaper-fashion on a drill press, miter wider stock. Groove a board for the miter gauge and bolt it to the table.



Lock rabbets are useful on drawer fronts. A circular saw or shaper makes easy work of the few cuts needed to construct the joint.



11. Similar to the rabbet shown at the left is this lock miter. It has the extra advantage of concealing end grain at the meeting corner.



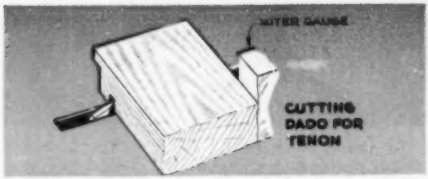
12. To miter the lock joint it is necessary to cut this additional rabbet on the sidepiece. The front piece is still made as at left.

the short rabbet and slot are shown in Figs. 12 and 13. A saw setup for mitering the short rabbet is pictured in Fig. 14. The table is tilted at a 45-deg. angle and the work rests above the dado saw. Mitering the long rabbet with a diamond-shaped cutter (Fig. 15) calls for equal care. Suit the dimensions of the rabbets to the firmness and thickness of the wood, but try to maintain the relative proportions shown in Fig 11. Thickness (T) of the locking flange is half that of the outer flange and only a third as great as the slot and corresponding rabbet in the meeting piece.

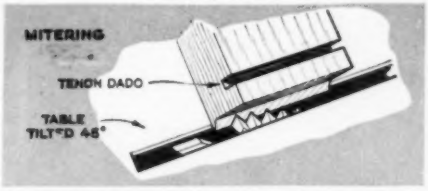
Reinforcing an ordinary miter joint with a spline produces a corner joint that is amply strong for most applications. Splined miters are particularly suited to the small shop because they can be made easily on common power tools. Miter an end and slot the miter near the heel with a regular saw blade or a dado head—depending on the thickness of the wood—as in Fig. 16. Tilt the table or arbor and keep the work pressed down securely.

A drill press, used shaper-fashion, also can be employed for splining. Figure 17 illustrates a method of slotting with a purfling tool. The shank acts like a shaper collar to guide the work. Such a tool can be made from part of a large nail. File teeth in the head and true the shank with a file as the spindle turns (Fig. 18).

Figure 19 shows a joint that locks from both directions; it's assembled by sliding



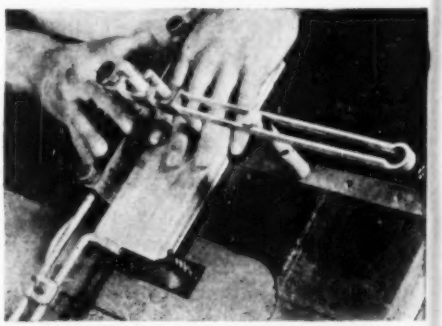
13. The sidepiece is then dadoed to receive the front tenon. It would be the same for the lock rabbet except for the projecting flange.



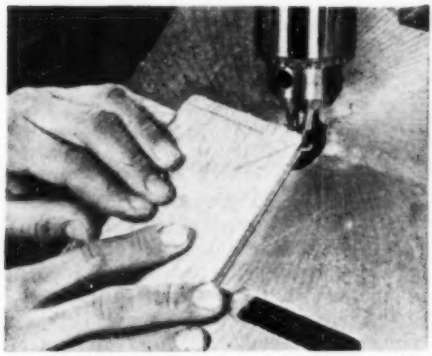
14. Both miters can be cut by tilting the saw table 45 deg. and trimming the waste with a dado saw. Accurate cutting makes a tight fit.

15. A diamond-shaped cutter in a drill press or shaper can be used to miter either the long rabbet (shown) or the short one at left.

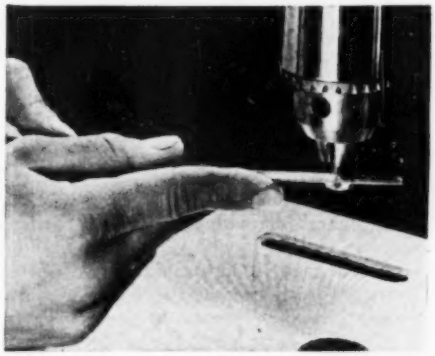
the tenons into their grooves, and needs no clamping. As there are several operations involved, this corner is used mostly for special jobs and in production work where many pieces are cut with one setup. There may be some tendency for cross-grained projections to split out; wide lumber must be flat or, at most, very slightly bowed. Four steps involved in making this joint are shown in Fig. 20; this sequence minimizes the number of machine changes. Molding heads with straight blades give the smoothest bottom cuts on wide grooves. These heads are available for the circular saw, drill press and shaper. Double-lock corners can be mitered in the same way as



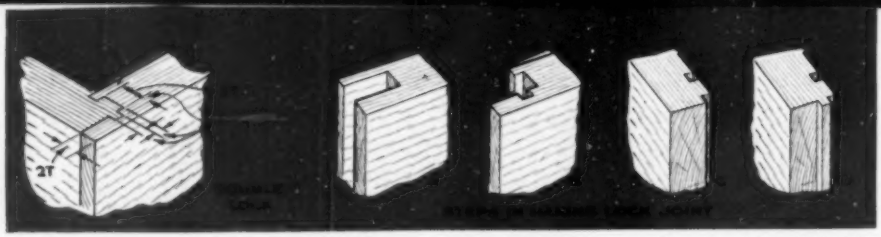
16. Splined miter joints can be made easily in the home workshop. Slot the mitered end near the heel with a regular blade or dado head.



17. A purfling tool in a drill press quickly slots a mitered end to receive a spline. Guide the work lightly on the shank of the tool.



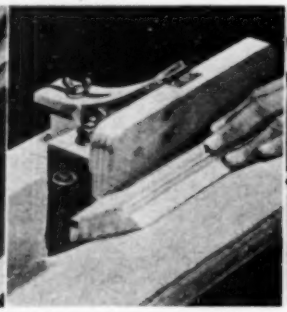
18. A large nail can be converted into this kind of slotting cutter. File teeth in the head and smooth and true the shank with a file.



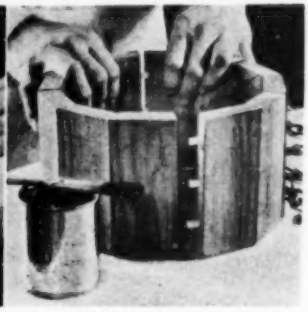
19. There's not much danger of this corner coming apart. Wood locks it from both directions.

20. These are the main steps in making a rabbeted double-lock joint. To finish the corner in a miter it would be necessary to leave a projecting flange along the edge of piece D.

21. A sloping auxiliary fence used in splining beveled edges helps to protect the arris.



22. On a shaper the table can be angled so the mitered edge will slide against the fence.



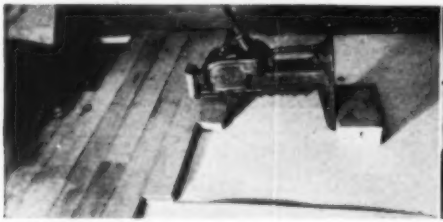
23. Built-up bowls and tubs look better when they're made with dowels instead of splines.

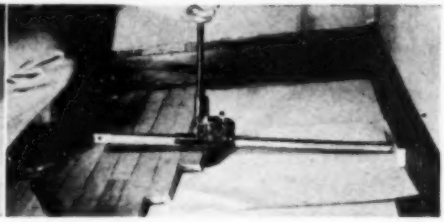
the single-lock type, but this requires leaving a small lip on the edge of piece D.

Most column-corners end up as jointing operations involving bevel cutting. It is possible to groove a bevel for a spline by tilting the saw table to fit the bevel. This way the work slides against the fence and the sharp arris rests on the table. A better setup is shown in Fig. 21. Here the table is set level; an angled auxiliary fence keeps the miter face on the table, protecting the arris. Figure 22 shows a similar shaper setup.

Handsome candy tubs and nut bowls can be built up from scraps of hardwood assembled as in Fig. 23. Dowels are invisible at the exposed ends. Bore dowel holes close to the inside faces of the staves and keep them shallow. END

Auto Jacks Tighten Joints in Hardwood Floor

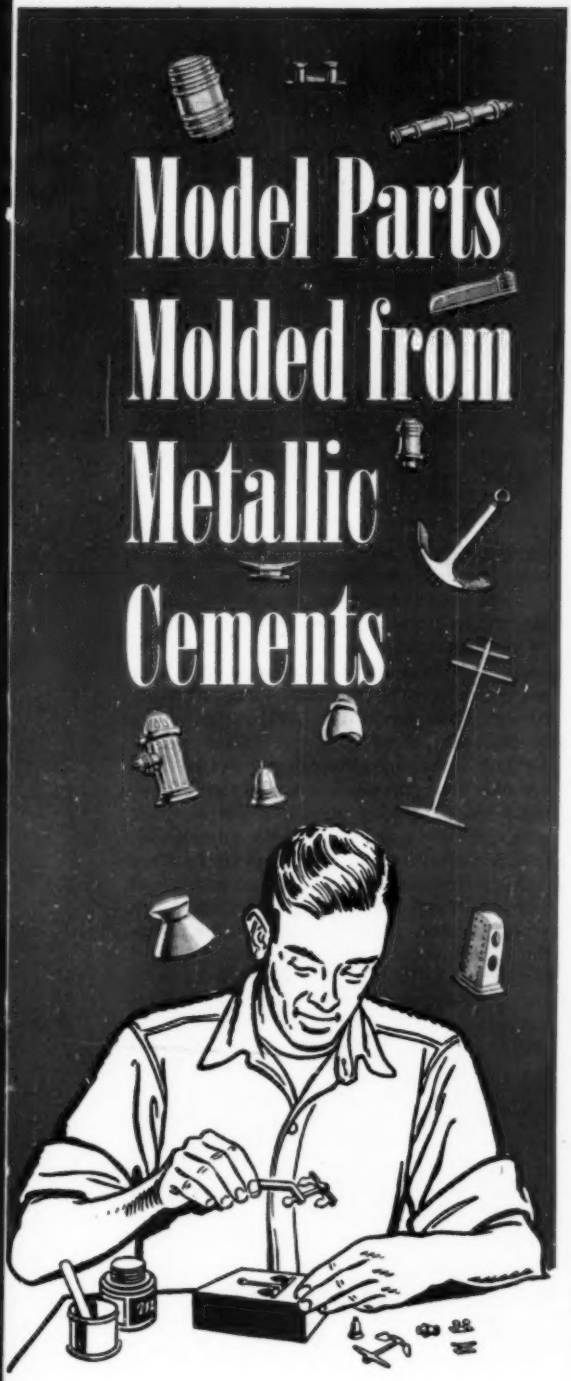




After finding it almost impossible to make tight joints with oak flooring that had become slightly bowed in seasoning, I devised the method illustrated in the photos above. The picture at the left shows the system I used over most of the floor area. A stop block is nailed to the subflooring and the jack is tightened to push the oak into position. Holes are drilled in the block to make it easier to pull the spikes.

A bumper jack proved more convenient in the final portion near the wall, especially where the diminishing space prevented use of a stop block. This jack might have been used as well in the open areas in conjunction with the wooden stop. Its greater length reduces the number of resettings that are necessary. Use small scraps of wood as jack pads to prevent damage to the flooring.—*E. F. Lindsley, North Prairie, Wis.*

Model Parts Molded from Metallic Cements



Built-in colors are possible. Mix a bronzing powder with the powdered metal and your finished castings will come out the chosen color.

Both the craftsman and handy man will find endless casting uses for these products. Some can be carved too.

By Walter E. Burton

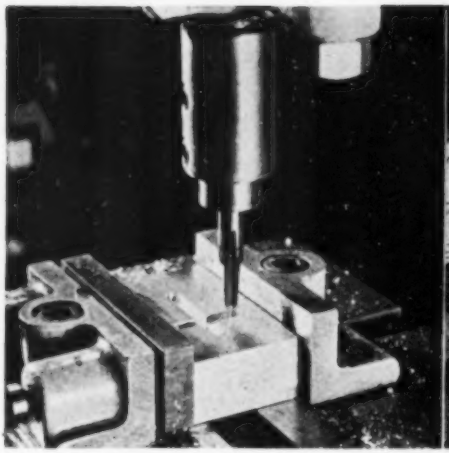
IT'S a rare product that the ingenious craftsman can't put to unexpected use. Take, for example, the various metallic cements now on the market. These are always handy to have in your work kit, if only for their regular jobs—filling cracks in metal, sealing joints, patching boilers, and the like. But that's just a beginning of their usefulness.

With these preparations, you can mold an endless variety of small objects. Some of the cements can be carved with ease.

For both the craftsman and handy man, this opens a big field of possibilities. A ship modelmaker can cast capstans, anchors, hatches, propellers, buoys, bitts, and other ship-model fittings. A model-railroad enthusiast can duplicate such accessories as hydrants, dummy switch stands, lights, transformers, locomotive domes, and bells.

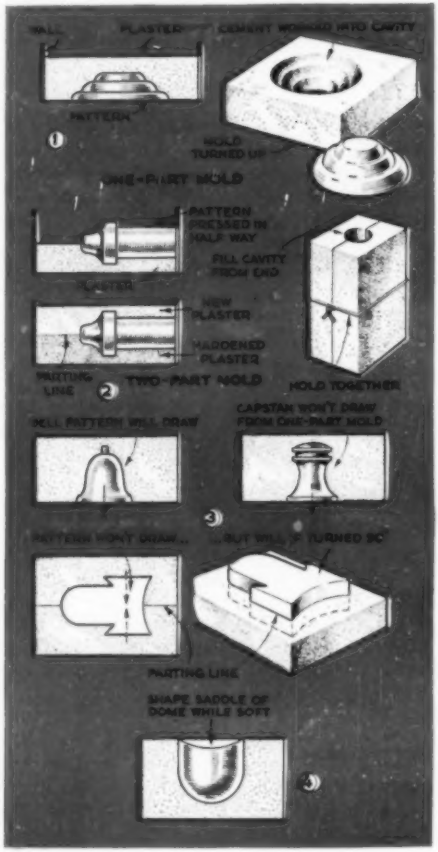
In your home, you can restore decorative details to furniture, picture frames, and art objects. Simply mold or carve the missing part from metallic cement. Then apply a finish to match the original. Often a surviving duplicate part will serve as the pattern for a mold.

Metallic cements are available as dry powders. For use, they are mixed with water. The type most likely to be found at the local hardware store is a general-purpose mixture of powdered iron. Others, intended



For a simple casting of original design, you can rout a mold in an aluminum or bronze block. One for a pendant ornament is seen here.

Mold cavity is given light coating of petroleum jelly to make the casting release easily. Cup grease can also be used for this purpose.



for special jobs, have a base of bronze, aluminum, or other powdered metal.

Some preparations call for a special liquid binder. In general, these are not well adapted to plaster-mold casting. It is difficult to keep them from sticking to the mold. However, some products of this kind are easily carved. Hercules Plastic Metallic Solder® is an example.

Most of the water-mixed, powdered-metal cements lend themselves well to cold casting. Modeling clay provides the simplest way of forming a mold. Get the type of clay that is waterproof and softened by heating.

An infrared drying lamp is an ideal heat source. When the clay is sufficiently soft, you can either press the object to be reproduced into the clay or press the latter against the surface to be copied. Pull carefully away without distorting the clay. For extra strength, cool the mold in a refrigerator.

A one-piece mold like this is the simplest you can make. The job can also be done in plaster (See Fig. 1 in the drawing).

Place the pattern on a flat surface with the smaller end up. Set around it a greased wall of cardboard, tin, or wood. Then pour in plaster and let harden. In use, the mold is turned upside down.

Some objects (for instance, the capstan in Fig. 3) won't "draw" from a one-part mold. Hence, a two-part mold is required. In foundry work, these often are made from a split pattern, but you can manage by pressing the pattern in carefully to its center line or

Cement mixture is then worked into cavity. Two pieces of wire are embedded in the cement, one being bent to a loop for mounting cross.

Casting lifts easily out of mold after cement has set. This takes only a few hours. For full hardness, put the ornament aside a day or so.

widest diameter (Fig. 2). When the plaster is hard, grease the mold surface and pour the second plaster part.

Watch out for projections that will lock into the plaster (Fig. 3). In such cases, it may help to turn the pattern 90 deg. You can often shape an undercut part while the work is in the filling cavity, as in the case of the locomotive dome (Fig. 4).

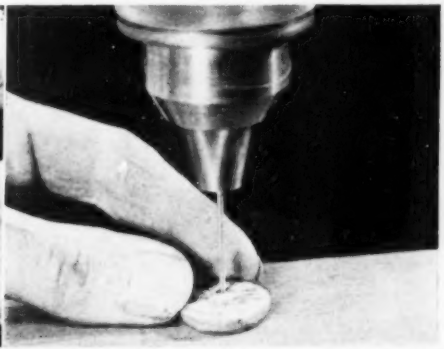
In making a plaster mold, add dry plaster of Paris to a small quantity of water, stirring until you have a fairly thick mixture. Coat the pattern with petroleum jelly or cup grease. Allow the plaster to set for several hours before removing the pattern. Then wash the grease off the plaster with lacquer thinner and coat the mold cavity and adjoining surfaces with shellac or lacquer.

Finally, coat these areas thoroughly, but not too thickly, with grease. The mold is then ready to receive the cement mixture.

For casting in modeling clay, you can use a general purpose variety of iron cement—Smooth-On No. 1®, Fix-Iron®, or Boyer's Iron Cement®. For reproducing fine detail, it may be better to pick a fine-grained type, such as Smooth-On No. 4AA®.

To the powdered cement add enough water to make a soft putty; the less water the better, but the putty should be thin enough to flow into all parts of the mold. Puddle the mixture into the mold with a

File is used to smooth edges of a button cast in the modeling-clay mold seen at left. Also note the button that was used as a pattern.



Button is drilled as if it were made of solid metal. Some cements may not withstand such work, however. It's best to make a test first.

A two-part plaster mold is made in this way. Here pattern is in place. It and the hardened first half are greased before adding plaster.

When plaster has set, grease is washed from mold cavity. It is then coated with lacquer and greased again before puddling in cement.

A hollow casting, made of iron cement, looks like this when mold is separated. The ceramic duck in background was used as the pattern.

thin stick or wire to eliminate air bubbles.

The cement usually will harden enough within a few hours for removal from the mold, but it may require a day or so to develop maximum hardness. You can reinforce the casting by embedding iron wire, bits of wire screen, or coarse cloth in the cement.

One disadvantage of a general-purpose cement is that it may expand considerably on setting. This may cause it to crack if used for a large casting. The little duck shown in the photographs split in two on the first attempt. This was prevented the next time by leaving the center of the figure hollow. The cement is worked in with a palette knife or similar tool through the opening. Some special-purpose cements, for instance Smooth-On No. 5 and No. 7®, are less metallic and do not develop expansion cracks so readily.

After taking a casting from the mold, set it aside to harden further. However, you can smooth rough spots, remove the flash, and fill air holes while the casting is semi-hard. For this smoothing and filling, a thin mixture of a casting-repair cement (such as Smooth-On No. 4AA) is excellent.

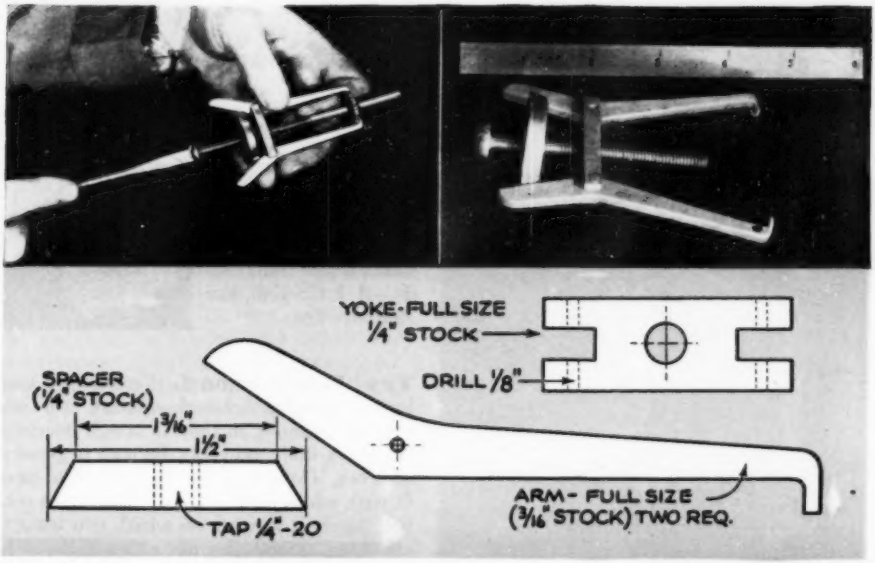
There are two ways of coloring the finished casting. When mixed with dry cement, the gold, bronze, silver, and other powders sold by paint stores will impart a color to the finished job. But this is not very economical, since you must use powder in considerable quantity. Also, you may weaken the cement itself.

The better way is to use paint, lacquer, or enamel. If the casting is iron cement, painting is desirable to prevent rust. If no coloring is desired, clear lacquer will serve.

When thoroughly hardened, most powdered-metal cements can be filed, ground, or sanded to remove high spots or roughness. But this should be done with care. General-purpose cements tend to crumble under the action of a file or other tool. Abrasive cloth or paper is probably best.

If you'd like to try your hand at modeling instead of casting, these cements also provide good material. When first mixed, the cement can be molded with the fingers.

A wire skeleton will reinforce the cement. In order to avoid the cracking that may occur in large masses, build up the work a little at a time. Most metallic cements harden fast enough to enable you to achieve the final shape in a reasonable time. However, you will have plenty of time for detail shaping with a knife or other tool. END



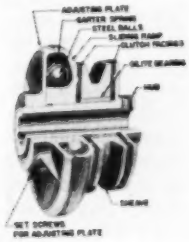
Model and Clock Gears Removed by Midget Puller

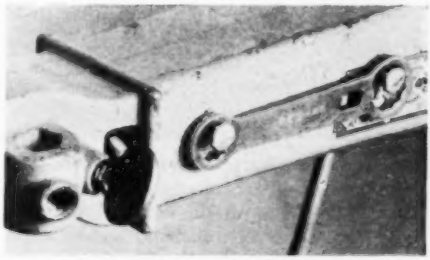
GEAR pullers, routinely used with husky work, are equally valuable for removing clock gears or model wheels from press-fitted shafts. This one, hacksawed and filed from bar stock, will not apply excessive inward pressure on the teeth of a gear. To use it, adjust the screw until its end rests on the shaft and the fingers are under the edge of the gear. The conical disk is then turned down until it touches the arms lightly and holds them in place. Then the screw is turned, both the disk and yoke maintaining their relative position as the shaft is pressed.

Make the yoke first, drilling and tapping the center hole and drilling the two ⅛" holes for the pins. Hacksaw out the two arms, shaping the gripping ends to suit the work. Cut a rough disk of ¼" stock, drill and tap it ¼"-20, and turn it in the lathe on either a threaded arbor or a chucked bolt and nut. Attach the yoke to the arms with ⅛" pins, lightly headed over. A 3" stove bolt, its end either cupped or pointed, serves as the screw. —*Richard C. Collins, Jr., Elizabeth, N. J.*

Automatic Clutch Is Compact

AVAILABLE in sizes down to 3½" in diameter, a new line of automatic centrifugal clutches made by the Salsbury Corp., of Los Angeles, is suited for use in motor scooters or bikes, lawnmowers, power saws, and similar applications. As engine speed increases above idling (when the clutch is disengaged), steel balls in a "garter" spring move out radially in the sliding ramp. This causes the sheave to be gripped between the clutch facings. Up to 10 hp. can be transmitted by the clutch.

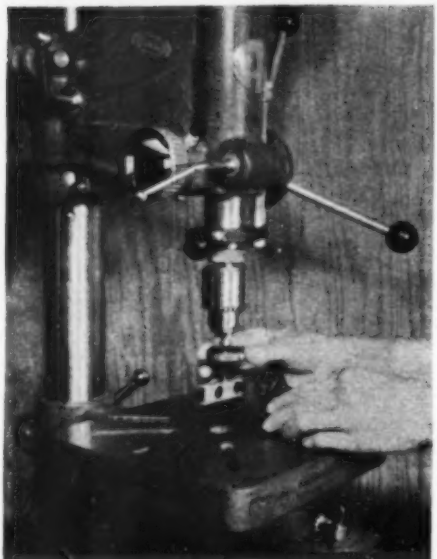




Wrenches Mounted on Tools

SPECIAL wrenches used on a jigsaw or any other power tool won't get mislaid so easily if you provide a special resting place for them. Here two 6-32 screws and tubing spacers keep a jigsaw wrench on the tool's overarm.—*Glenn A. Wagner, Delmar, N. Y.*

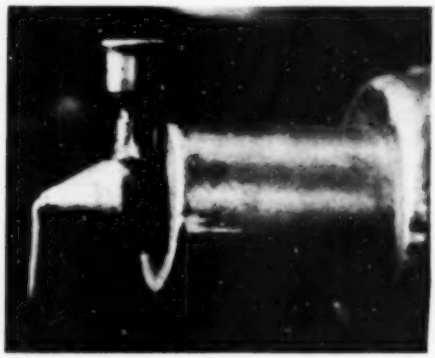
NEW SHOP IDEAS



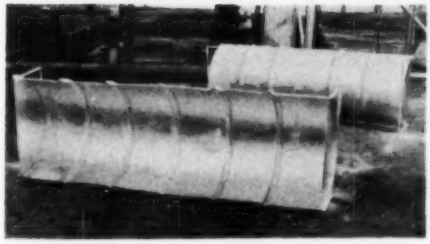
Sensitive Tap Guide. Drill-press tapping assures squareness, but it has drawbacks. The mass of the spindle will often mask tap resistance and hence cause breakage. And usually the threads are too fine to advance the spindle, requiring you to feed with one hand. This device overcomes both drawbacks. A bushing drilled a running fit for tap shanks is chucked. Tighten the collar on the tap and lock the spindle feed. Turning the collar by hand gives sensitive control.—*Joseph Tracy, Manhattan, N. Y.*

Salvage Solder. If you want to keep an eye on workshop pennies, save waste bits of solder. Melt them in a ladle, or even a tin can, and pour into a length of aluminum angle held on a couple of wood blocks. The strip of solder comes free readily.—*R. J. Carabin, San Antonio, Tex.*

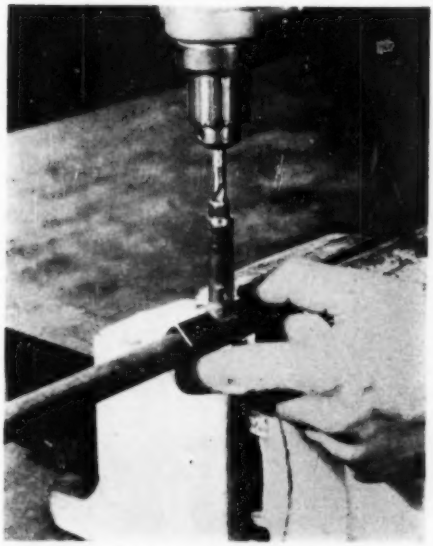
Try White Lead. Commonly used for lubricating tailstock centers, it's also good for running in tight or rough bearings. Its heavy body prevents damage to bearing surfaces. Coating both members of a press fit with white lead will keep them from seizing. Apply it to work on which you want to cut clean, smooth threads, either in the lathe or with a die. For turning a good finish on steel, leave a few thousandths, coat with white lead, and take a finishing cut with a fine feed at higher speed.—*J. J. McDowell, Atlanta, Ga.*



Cup Lubricates Center. You can forget the oil can and concentrate on the job if the tailstock center is fitted with a grease cup. The self-lubricating point is especially good on heavy work or repeat runs. Anneal the center, drill and tap it for a ⅛" pipe nipple, and drill a small hole dead center in the point to meet the threaded one. Reharden the center and mount a grease cup on a short nipple to raise it above the ram for easy filling. Use soft cup grease.—*John C. Albright, Santa Monica, Calif.*

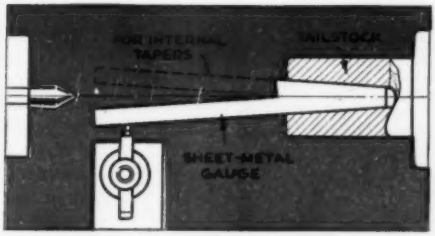


Lathe Pans from Oil Drums. Chip pans for lathes can be made from discarded oil drums. They're comparatively light and easy to handle, and reduce fire hazard because they don't absorb cutting oil. Cut out the top drumhead with the bung hole. Split the drum in two lengthwise, thoroughly clean the inside, and weld the two open ends together. Shape and weld on strap-iron feet to prevent tipping.



Drilling Round Stock. You can drill accurately on diameter even with an electric drill with this simple jig. Weld or silver-solder a 2″ length of steel tubing to a short piece of angle stock. The tubing must be a running fit for the drill, or bushed to suit, and positioned accurately at 45 deg. to both faces of the angle as well as at 90 deg. to its long dimension. If accurately made, the jig insures a true hole automatically. Just hold it on the work firmly as shown above.

Pin Yanker. Working by impact, this cotter-pin puller gets even stubborn ones out fast. Grind one end of a 12″ length of 3/32″ steel wire to a sharp point (a heavy bicycle spoke will do). Anneal the sharp end, bend to a short hook, reheat, and quench to harden. The hammer is a 3″ length of steel bar stock sliding freely on the wire. Bend a good-sized loop on the far end of the wire, or braze on a nut or the spoke nipple, for the hammer to strike against in use.—*J. W. Rocke, Globe, Ariz.*



Setting for Tapers. Having to turn a lot of Morse tapers on the lathe, I cut a piece of sheet metal to a good fit in the tailstock taper, leaving a straightedge on one side. For external tapers, I run the tool or an indicator up along this as shown. For internal ones, I turn the gauge to the back.—*H. Moore, Leeds, England.*

Tap Drives Screws. A broken four-flute tap makes a good screwdriver for recessed-head screws. Grind the points to fit, or anneal and file them. A regular tap wrench gives enormous turning leverage.—*Victor H. Lamoy, Upper Jay, N.Y.*

Reflector Held on Tripod. A support for a foil-covered cardboard reflector may be made from a hardwood block. Press a ¼″-20 nut in an undersize hole in one side of the block. In the opposite side, cut a slot to take a thin piece of wood that you've glued or taped to the back of the reflector. Glue this piece in the slot. Mount the holder on a tilt-top tripod.—*William B. Woodington, Philadelphia.*

Lens Enlarges Reflex Image. Built to fit most 2¼″ by 2¼″ reflex cameras, the Stroba® focusing magnifier incorporates a lens in a threaded, focusing eyepiece. It enlarges and brightens the image you see on the ground glass. Stroba Manufacturing Co., New York City, prices it at about $8.

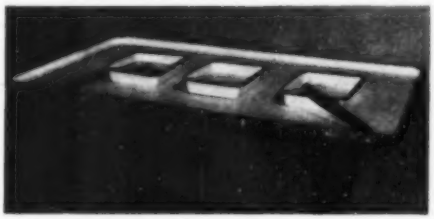
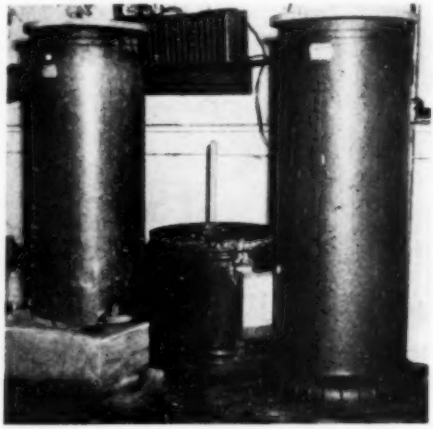
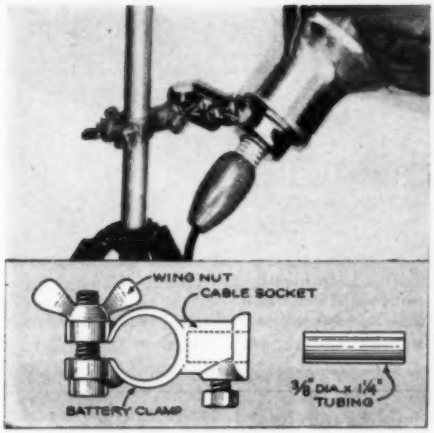


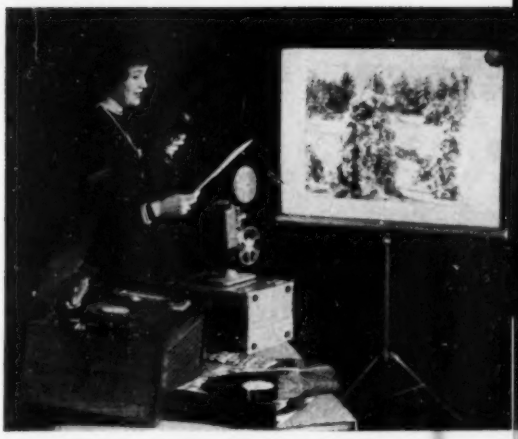
Table-Top Photo Bench. A porcelain-enamel top, lifted from a kitchen table and turned upside down, makes an excellent working surface for photo processing. If solutions are spilled from the tray, the lip around the top keeps the liquid from dripping on the floor. If you wish, the inside of the top can be given a coat of paint.



Drain Tile Makes Tank. Glazed drain tile, set in concrete, made these deep processing tanks for my commercial studio. Melted paraffin inside prevents the concrete from absorbing solutions. Drainpipes, not visible in the photo, are buried in the bases. I've run 3,000 rolls of film through them.—*F. E. Addy, Greenfield, O.*



Clamp Holds Low-Angle Lamp. Many telescoping lamp standards are so built that the reflector can be lowered only to about 40" from the floor. I got around this limitation by using a piece of metal tubing and a battery clamp, as shown above. When I want low-position lighting, I remove the reflector from the top of the stand and attach it to the tubing in the cable socket. The wing nut holds the battery clamp anywhere on the standard.—*Arthur Trauffer, Council Bluffs, Ia.*

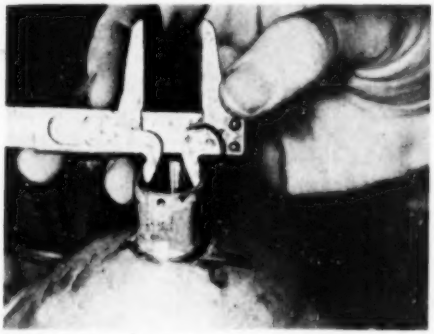


Sound Synchronized to Movies. Used with a wire recorder, a $15 Sears Roebuck kit allows sound to be dubbed into any home movies. The mirror clipped to a corner of the screen reflects intermittent light back to a printed stroboscopic disk mounted on the recorder drum. When movies are shown, the projector speed can then be adjusted to keep accurate step with the recorder. Four disk records are also provided to supply miscellaneous sound effects in preparing the wire.

Liquid Acts as Filter. Dipping flash bulbs in Jen-Dip Red Label® gives them an amber coating that makes unnecessary the use of a compensating filter for flash color shots. No increase in exposure is needed, according to the maker, Jen-Products Co., New York City. The product retails for $1.50 a bottle, enough for 300 bulbs.

Hookup for Flash Shots. With the unit pictured here, floodlight reflectors can be used for open-flash shots where house current isn't available. Two 1½-volt flashlight batteries, taped to a base on which a receptacle is mounted, furnish the current. Solder the leads to the batteries. In use, the cord from the reflector is plugged into the battery unit, and the switch on the cord or socket is used to fire the bulb.

Drill a hole lengthwise through the hard fiber insert of socket near edge with No. 30 drill. This hole takes one lead of extension wire.



Reflector neck must grip the socket in fairly tight friction fit. Ream it out slightly to take the socket plus the insulating paper.

Headlight Reflector Focuses Your Flash

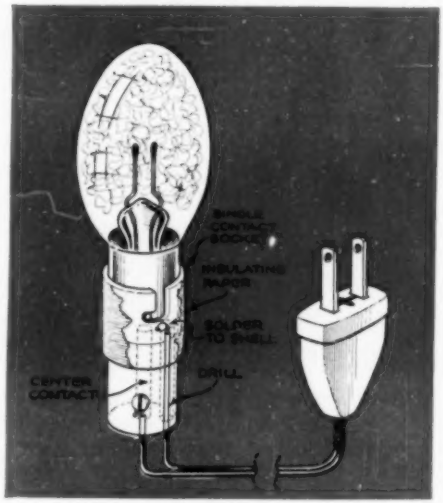
BESIDES putting secondary light where it's wanted, this extension flash unit enables you to focus the beam as needed. Four or five of the units can be made for the same amount that you'd pay for a single complete outfit at a camera store.

An auto headlight serves as the reflector. You can buy these at salvage yards for 50 to 75 cents. A quarter spent at an auto-accessory store will buy a single-contact socket that will take midget flash bulbs.

Adapt the socket for use by drilling as shown. Thrust one lead of the wire through this hole and solder to the inside of the socket shell. Connect the other lead to the center contact with the setscrew.

Insulating paper on the socket is optional, but it acts as a safeguard against possible shorts through the reflector. Sliding the socket in and out focuses the light.

Attach a male plug to the wire to suit the synchronizer on the camera, fit a spring clamp to the reflector, and you're ready to go.—*M. M. Jacks, San Francisco.*



To insulate socket from reflector, cut down lining from old incandescent fixture. Midget flash bulbs just fit the auto socket shown.

Adhesive Easel Holds Enlarging Paper Flat

COATED with a special gelatin adhesive, this plywood easel can be used either for enlarging or copying. It also provides a handy way of holding paper if you use a horizontal enlarger.

Make the adhesive as outlined below. Be sure to stir the first mixture until the cooking gelatin has dissolved completely. The alum solution should not be added until you are ready to apply the adhesive. Once the alum has been added, the gelatin mixture cannot be remelted. However, the stock gelatin mixure can be put aside and remelted. The board can be used repeatedly.

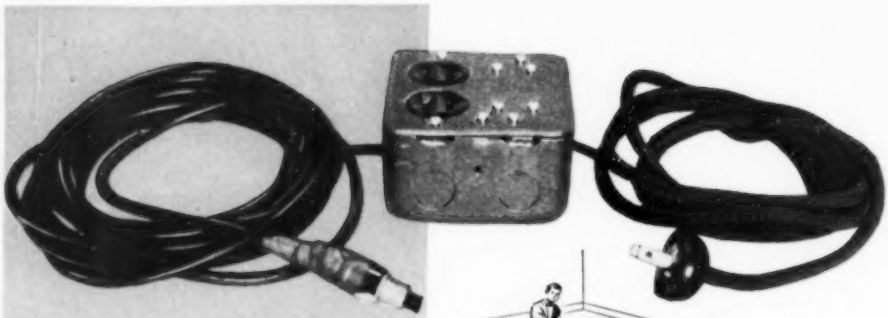
Prints without borders are a cinch. Just press down the paper on board. It peels off easily.

Mix 1 oz. glycerin and 1 oz. Karo® syrup with 13 oz. water. Soak 1 oz. gelatin in this 15 min. Then heat to 120 deg. F., stirring to dissolve gelatin. Add 50 grains of sodium bisulphite.

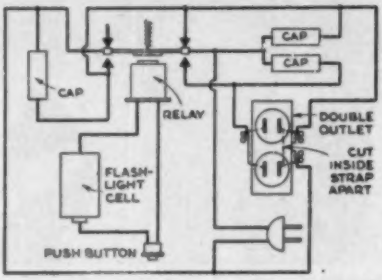
Dissolve 8 grains of potassium chrome alum in 3 oz. water. This is a hardening agent. When ready to apply adhesive, add to hot gelatin mixture—1 teaspoon to each ounce of latter.

Apply adhesive while it's hot, using a second coat if necessary. Allow to set for 24 hours.

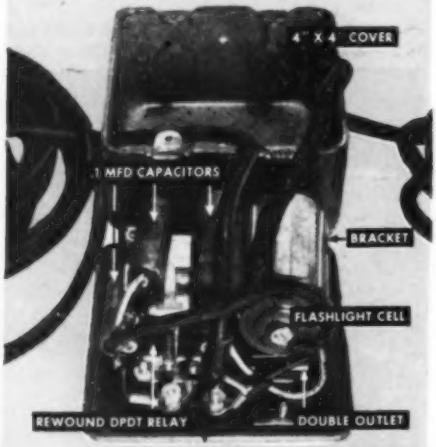
Press photo paper down firmly. If board isn't tacky enough, wipe it first with a damp cloth.



Remote Switch Controls Flood Lamps



The relay, double outlet, condensers, and flashlight cell are mounted on the cover of a standard electrical outlet box.

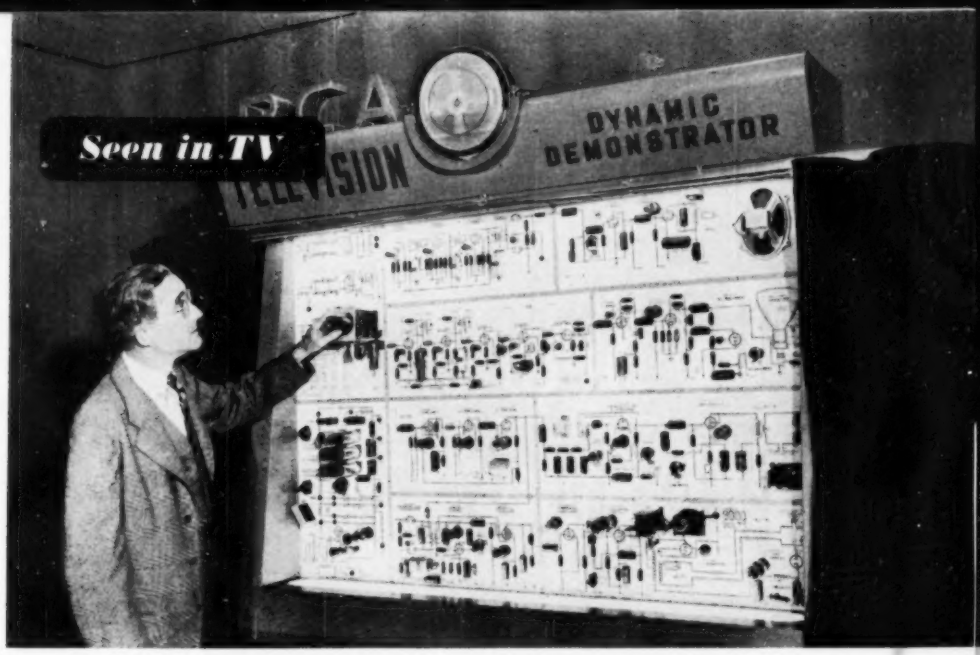


IT'S ALL right to ask your camera portrait subject to warm up for the job of posing, but don't overdo it. Cooking him to a crisp while you are adjusting lights, camera, and background doesn't help the picture. It just shortens lamp life. Here's a lamp dimmer that solves the problem conveniently—a push button at the end of a low voltage wire is the only thing you have to hold on to. The rest is contained in a small box. You can't forget to dim the lights, either, because that's their normal position.

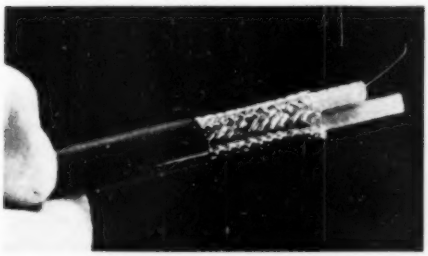
A war-surplus DPDT relay and three .1-mfd. paper capacitors (rated at 200 volts or higher) may be purchased at many radio-parts stores; the rest of the equipment is standard hardware. A 24-volt relay was used, but the original winding was removed and the core rewound with No. 22 enameled magnet wire. The number of turns isn't critical so long as the spool is wound full. If the relay seems sluggish when operated on the 1½ volts furnished by a flashlight cell, stretch the return spring a little.

The double outlet, which is constructed to feed two plugs in parallel, must also be modified for series use. Cut or saw one of the terminal straps in two.

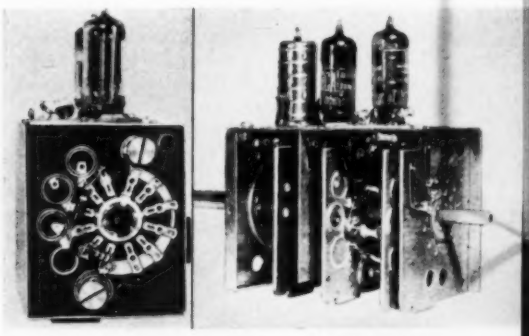
One pair of relay contacts remains normally closed, putting the two outlets in series. Pressing the button closes the other pair of contacts and puts the outlets in parallel. Wires were soldered directly to the flashlight-cell terminals, but you can substitute a bent-metal holder with clip contacts.—*Wesley O. Walker, Montebello, Calif.*



Demonstrator Shows TV Ills. A complete, working television receiver flattened out on a 3½′ by 5½′ panel is expected to help servicemen identify and cure many set troubles. The demonstrator above, built by John Meagher, of RCA, is now touring the country. It is used in conjunction with a slide-illustrated lecture to show the effect of various parts changes on the received picture. The circuit is broken down into 10 main "block" components, and each element is diagramed on the panel. Plug-in connections are used on most parts so they can be removed or replaced for demonstration.



Lead-In Cuts Interference. A new 300-ohm shielded line, said to reduce interference in television reception, is offered by Federal Telephone & Radio Corporation. Known as K-111, the line has characteristics similar to other 300-ohm twin-lead but is shielded to eliminate transmission-line pickup that frequently introduces distortion between the antenna and receiver. Among the chief sources of TV "noise" are automobile ignition, fluorescent lighting, and radiation from electrical equipment. Minimizing stray pickup at the lead-in improves the signal-to-noise ratio and results in better picture and sound reception.



Station Selector Is Stamped. Uniform inductances, obtained by stamping out ribbons of copper to any desired shape, are used in the television station selector above. Simultaneously with the stamping, the copper is cemented to a composition plate, insuring against later variation due to movement or handling. Die stamping has been adapted to the mass production of relatively inexpensive television components by the Franklin Airloop Corporation, Long Island City, N. Y.

Converting AC-DC Sets to Portables

New tubes and some minor changes turn this midget radio into a self-powered portable—and back again.

Need a portable? Switch your AC-DC midget to battery power. It costs little and doesn't harm the set.

By William Norton

SUMMER months are outdoor months, and radios that can't get out into the open with you don't fit into the picture very well. But if you already own a number of housebound receivers, you may have some objection to buying or building still another set. You don't have to. One of those AC-DC midgets has the makings of a good battery portable. It isn't even necessary to make any permanent changes in the circuit. To restore the portable to AC-DC operation, you need only replace the original tubes and throw a switch.

Remove all tubes before starting to work on the set. Mark each socket with the number of the original tube and its battery replacement.

The main consideration is tube substitution. The table on page 225 covers the commoner tube lineups. It is impossible to show all variations, but the chances are that if the set uses standard-size tubes and was manufactured in the last dozen years, it will fall into one or another of the main groups listed. The more recent midgets employing miniature tubes are not included since these can't readily be converted by the method described. In some cases you may also find a set that overlaps two groups.

Many of the tubes in the chart offer the possibility of simple plug-in substitution. All you have to do with a 7A8 converter, for example, is lift it out of its socket and slip in a 1LA6. Pin connections are the same.

Some problems arise, however, when it comes to changing the detector tube. Most AC-DC sets use dual diode triodes in this stage while battery detectors are generally single diode triodes or pentodes. For the first two groups the 1S5 miniature diode pentode is suggested. In the third group you have a choice of this tube or the 1H5. Since the latter tube is a triode, it may not give as much amplification. However, it can be plugged in in place of the 6Q7, while for the 1S5 you'll have to make an adapter socket.

The adapter socket for a 1S5 consists of a

7-pin miniature wafer socket mounted on top of an octal or lock-in base—whichever matches the socket in the set. For the adapter base use a burnt-out tube. If you don't have the right kind in your workshop, you can pick one up for a few cents from a local repairman. Place the tube in a paper bag and give it a sharp hammer blow to break the glass. Using pliers and cutters, remove the loosened elements and break off any remaining glass.

Octal bases are easier to work with since the prongs are hollow on the inside. Remove the old connections by melting the solder and make new ones by inserting wires into the hollow prongs and flowing in solder. Use solid tinned wire of fairly heavy gauge—No. 18 is about right—making sure that the wire is well insulated. Bare wire can be covered with plastic spaghetti.

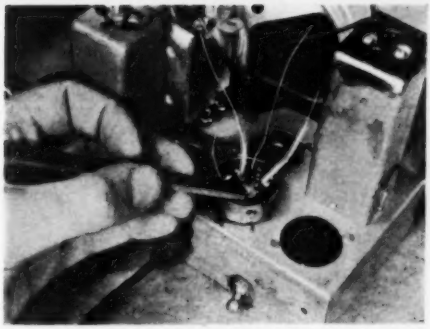
If your set uses lock-in tubes, file the part of the pin that protrudes inside the base. Filing cleans the metal and allows the added wires to be soldered on firmly.

Where the 1S5 pentode is used to replace a triode, some provision must be made for the screen grid. This is connected to B-plus through a 680,000-ohm, ¼-watt resistor. A midget .01-mfd., 200-volt paper tubular condenser provides a bypass path to ground. Both these parts are mounted directly on the miniature socket. In the chart, one side of the resistor is shown connected to pin 2, a dead prong used as an anchor point.

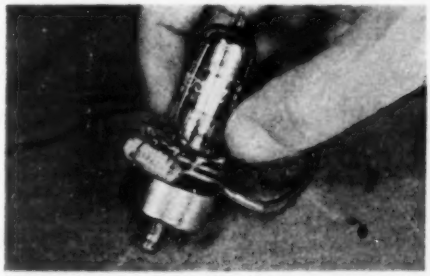
If you plan to reconvert the set to AC-DC use at any future time, it is advisable to use phone tips and jacks for B-plus and other connections so that the original circuit can be easily restored. Find a B-plus point in the receiver—usually at the screen grid of the power output tube—install an insulated phone jack on the chassis, and wire the two together. The lead from pin 2 of the 1S5 socket can terminate in a phone tip and be plugged in whenever the tube is inserted.

A second lead from the adapter socket goes to another phone jack on the chassis. This connects the second diode plate in the original circuit to A-plus through a 1-meg. resistor. The reason for this connection is that the single-diode 1S5 is being used in place of a dual-diode detector in the original set. In some sets this wiring isn't necessary so if you like you can try the set first before inserting it.

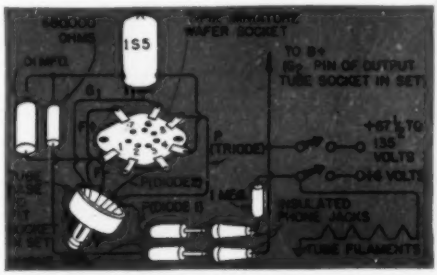
All AC-DC receivers have tube heaters connected in series. By leaving them that way it is possible to avoid rewiring. Make sure there are no resistors in series with the heaters. If there are, they will have to be shorted out with a switch. One end of the filament string is usually grounded at the detector stage. Connect the negative A-battery lead at this point. The B battery is *not* grounded to the chassis directly; instead it goes through a bias resistor. The installation of this resistor—which should be between 330 and 680 ohms—is shown in one of the drawings. One side of the output tube's grid resistor must be disconnected from chassis or ground and wired to B-minus. When the set is restored to AC-DC operation, the small



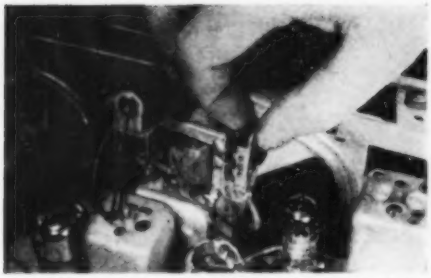
To make an adapter socket, select a tube with the right base and break off the glass. File the pins that protrude inside a lock-in base.



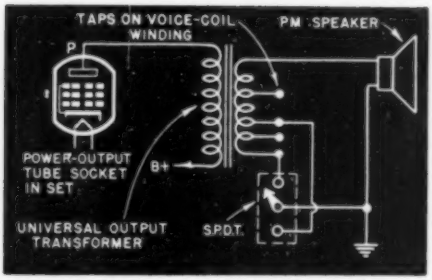
This adapter allows the battery tube to be plugged in in place of the original tube. New wiring is made at the socket, not in the set.



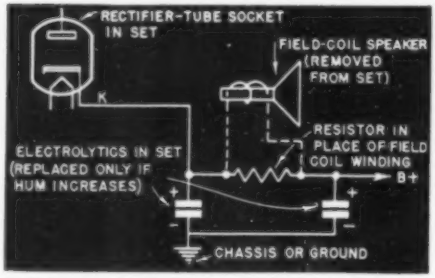
A 7-pin miniature wafer socket, used upside down, and the base of a burnt-out tube are wired together to make the adapter socket.



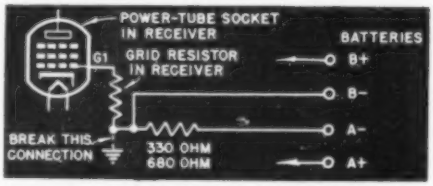
A slide switch soldered to the frame of the output transformer changes the impedance of the transformer to match the new output tube.



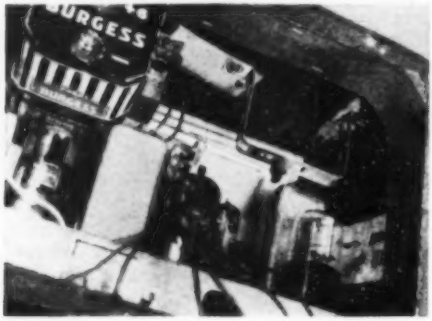
The switch shown at the left is wired across two taps of a universal output transformer. Select the best tap for each output tube.



Field-coil windings are usually used as filter chokes. When replacing such a speaker with a PM unit, insert a filter resistor as shown.



Lift the grid resistor of the output tube from ground and connect it to B-minus. Insert a bias resistor between this junction and A-minus.



Batteries are held in place by metal strips. For 4-tube lineups, use a 6-volt A battery; B voltage can range from about 67½ to 135.

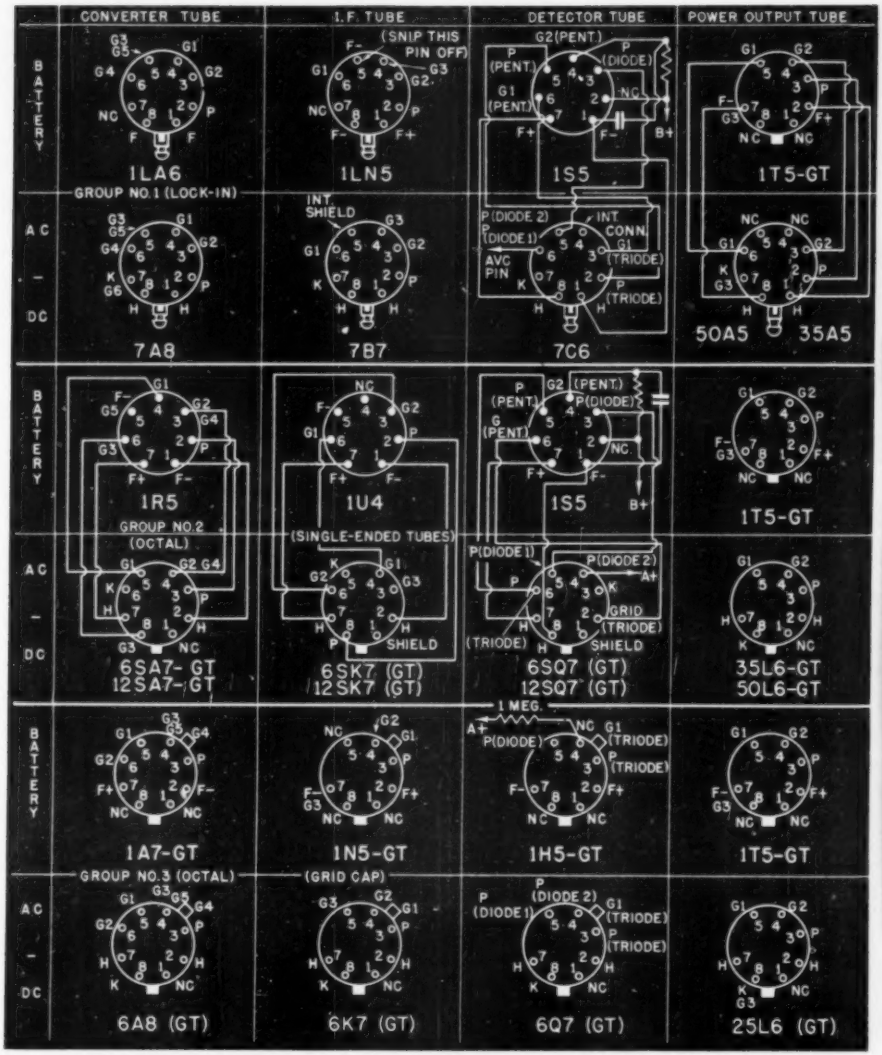
bias resistor, in series with the much larger grid resistor, has virtually no effect.

The A-plus connection from the battery is soldered to whichever heater lug on the power-tube socket goes to the rectifier-tube socket. The rectifier is omitted from the circuit. Wire the plus side of the B battery to any B-plus point in the receiver. Both the A and B connections are made through a DPST toggle switch. This becomes the on-off switch for battery operation.

Another important point in battery operation concerns the speaker. Check the one in your set to see whether it is energized by a permanent magnet or a field coil. If it is of the latter type, you will have to replace it with a PM speaker. Select one of the same size so it will fit the cabinet.

If your speaker has a field coil, the chances are that the coil also acts as a filter choke. A 2,200-ohm, 2-watt resistor has to be installed between the two wires that are disconnected from the field coil. Since a resistor doesn't give as much filtering action as a coil, there may be an increase of hum when the set is used on AC. Try it out, and if you find there is too much hum, replace the filter condensers with two 40-mfd. capacitors or a dual unit containing two such condensers in one shell. They should have a rating of 150 volts or more.

Another point relating to the speaker—whether you have to change yours or not—concerns the output transformer. Battery tubes generally have higher load impedances than the output tubes used in AC-DC sets. As a result the original transformer may not give proper matching. Should you find this to be the case, replace the transformer with one of the universal type and select the output taps that sound best on each service. When you have picked the right ones, wire

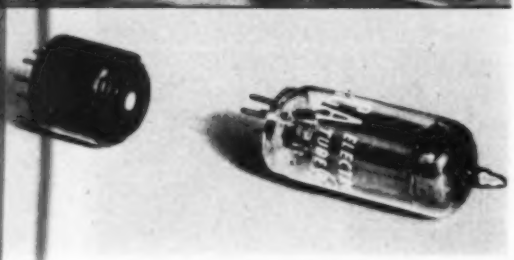


Pick your tube lineup. Battery substitutes or adapter sockets are given. All are top views.

them across a SPDT switch as shown in one of the drawings. The switch allows you to select the correct match for either battery or house-line operation. Like many of the other alterations, this one won't be needed in all cases. If you already have a PM speaker in your set, try the battery conversion with the original transformer before investing in a new one.

Batteries can be held in place by metal straps. Fasten the straps with wood screws, or with nuts and bolts if you have a plastic cabinet. For series filaments, a 6-volt A battery is about right for a 4-tube circuit, omitting the rectifier; B voltage can vary more. Depending on the space in the cabinet, you can use one or two 67½-volt batteries in series to give a total of 135 volts, or two 45-volts totaling 90 volts. This gives you a choice of 67½, 90, or 135 volts. The set should work with any of these arrangements, but more voltage usualy gives higher output. END

Pads Reduce Phone Pressure. This new lightweight headset manufactured by Telex, Inc., Minneapolis, reduces ear fatigue by eliminating pressure on them. The two receivers rest on the sides of the head and sound is piped through plastic earpieces, which are individually adjustable. The set includes a volume control.

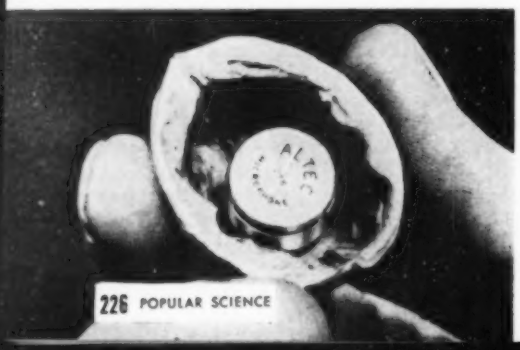


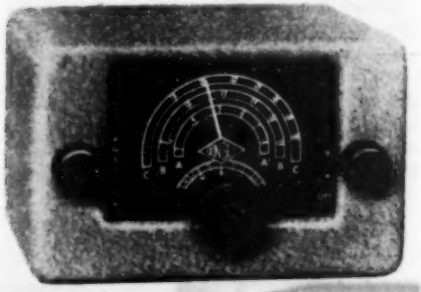
Plug Allows Testing from Top. A socket adapter made by RCA facilitates troubleshooting receivers that have miniature tubes. The adapter consists of a plug and socket that makes tube-base connections accessible from the top of the chassis. Most circuit elements can thus be tested or measured from the tube side, often without removing the set from the cabinet. The adapter costs $1.50.

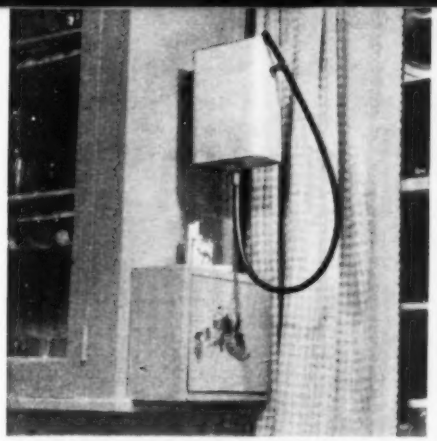
Transformer. A plug-in input transformer used for matching low-impedance microphones and pickups to the high-impedance input circuit of many audio amplifiers is being produced by United Transformer Co., New York. The unit matches sources from 50 to 500 ohms to amplifier grid circuits. Contacts are made by a standard phone plug and jack.

Tiny Mike Has High Fidelity. The small size of the microphone pictured in a walnut shell below is only a by-product of the search for a high-quality sound reproducer, according to engineers of the Altec Lansing Corporation, New York. The unit weighs less than ¼ oz., but is said to give completely flat response from 20 to 15,000 cycles. Absence of peaks in the audible range and reduction of feedback make it suitable for public address as well as broadcasting. With equipment, it costs $190.

Tunes Short Waves in Car. A converter that allows an ordinary auto radio to pick up short-wave broadcasts is being marketed by the Gonset Co., Burbank, Calif. Deriving power from the car set and using the regular antenna, the unit covers all frequencies from 3 to 30 megacycles. It can be switched out to permit normal operation of the auto radio.







Soap powder flows by gravity when the hose is lifted from its clip and lowered to the sink.

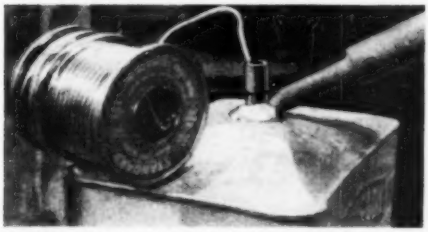
Hopper Ends Soap Sneezes

SCREWED to a cupboard near the sink, this powdered-soap hopper does away with the usual unsightly carton and the explosive sneezes it often produces. When dishes are to be washed, the hose is unclipped and held down to let soap flow.

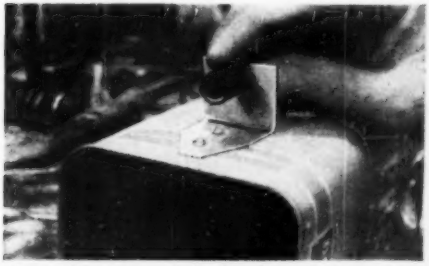
The dispenser was made from a one-gallon antifreeze can. After removing one end with a rotary opener, I dished the other outward and cut a hole in the center, bending out several tabs. I then soldered a 1" length of metal tubing in the hole, locating the upper end flush with the bottom of the can. A piece of ½" hose was slipped over it.

To hold up the end of the hose, I cut a piece of sheet metal 1" by 2½", bent it to a right angle, cut out a notch in one end, and bolted the other to the hopper.

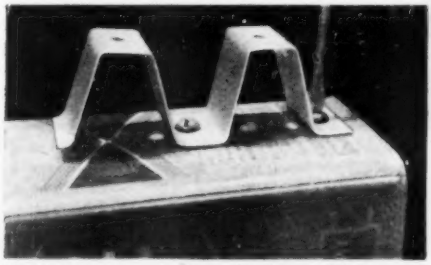
The hopper was painted to match the trim.—*R. W. McCandless, Manhattan, N. Y.*



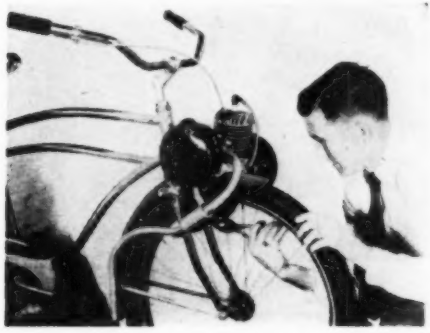
Solder metal tubing in hole centered in one end. Note how this end has been pressed out.



Hose clip was made by bending sheet metal to right angle and cutting a notch for the hose.



Hopper is mounted on kitchen cabinet with this bracket. It can be bent from sheet metal.



Pedaling Starts Bike Engine

WHEN you shut off the gas completely, the compression of this friction-drive bicycle engine is automatically released. This feature is said to eliminate the need for a clutch and to make it easy to pedal the bike in starting the engine.

Manufactured by the Travis Products Co., of Chicago, the engine sells for about $70, with all accessories. It is said to give 150 miles on a gallon of gas and has a top speed of 25 m.p.h. It can be installed with a screwdriver and pliers.

Just the thing for those hot summer afternoons, the finished tumbler—bound with colored plastic cord—holds a long, cool drink.

Electricity Cuts Bottles into Tumblers

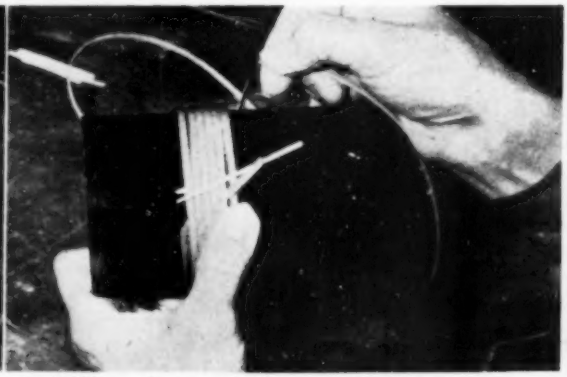
By James Blane

FIST-SIZED tumblers that hold a real drink can be cut from old bottles. They're nice additions to a shelf in your den, or you can make them up in sets for gifts. Materials for the jig cost only a few cents and your raw material—bottles—cost little or nothing.

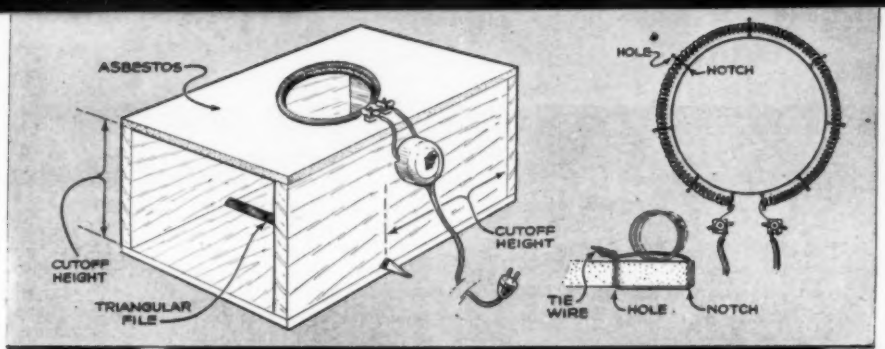
Any old crate or box will do for the jig. If you want a de luxe job, though, you can build it of plywood. Leave one side of the box open. For a top, use a piece of asbestos board. Cut a hole in the asbestos about ⅛" larger than the bottles you'll work with, using a coping saw or a circle cutter. The top of the jig pictured here is detachable so I can use tops with different size holes. Wing nuts hold the wiring connections.

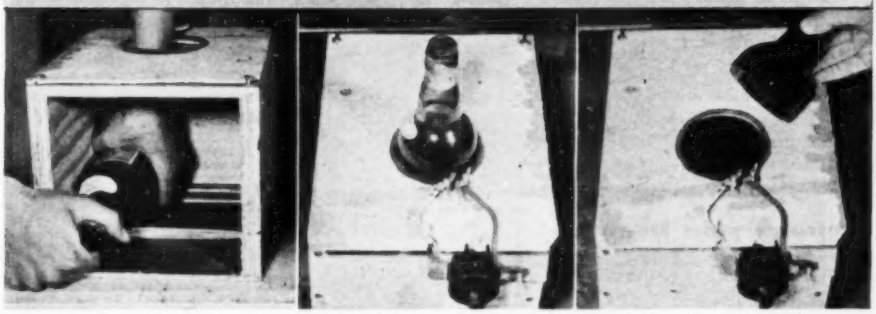
On the inside bottom, mount a triangular file. The location of the file will determine the height of your tumblers. Drill a hole

1. Using raffia or plastic cord such as that sold by handicraft shops, let the starting end hang down and cover it with succeeding wrappings.



2. Halfway down with the wrapping, lay a toothpick next to the glass and cover it with the remainder of the wrappings.



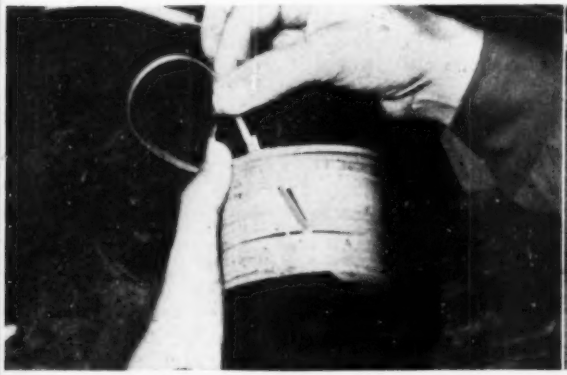


Here are the steps in cutting down bottles to tumblers. Left, to score a bottle, hold it firmly on the triangular file with the juice off and rotate it slowly. Be sure the score completely circles the bottle. Then place the bottle in the hole so the score is level with the heating element, and turn on the current. You'll hear a ping when the glass cracks. Then lift off the top.

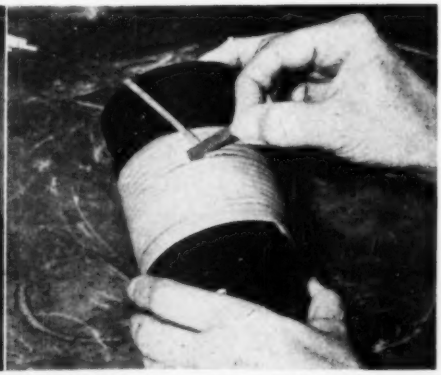
in one side to take the tang of the file. The other end of the file can be held with a staple if the box you use is wider than the file is long. Otherwise, the file may be held in holes through each side of the box. At the back of the box floor tack a strip of wood as high as the file. This will level the bottle when you lay it on the file for scoring.

A switch, a couple of small bolts and washers, and a 600-watt replacement heating element complete the jig. About ½" from the edge of the hole in the asbestos, drill two holes 1" apart for the bolts. Between the heads of the bolts and the washers, attach the ends of the heating element and the leads to the switch.

To hold the heating element around the circumference of the hole, drill a series of small holes ⅛" from the edge. Short pieces of wire threaded through these holes will



3. Thread the last end of the wrapping in a needle and push it up along the toothpick. Then draw the cord up under the turns.



4. Withdraw the toothpick and pull the wrapping up tightly. Cut the end close to the glass, and it'll slip under the folds out of sight.

keep the element in position around the rim.

Now you're ready to start cutting bottles. Lay a bottle on the file with its end resting against the back of the box and its side against the side of the box. Press down firmly on the bottle and rotate it against the file. If you want a shorter tumbler, put a block of wood between the bottom of the bottle and the back of the box. This will move the bottle out so the score mark will be nearer its bottom.

Lower the bottle into the hole so the score is level with the heating element. If necessary, put a block under the bottle to locate it properly. Then turn on the juice. As the element glows red, you'll hear a ping. That's the glass cracking. The current may be shut off and the top of the cut bottle lifted off.

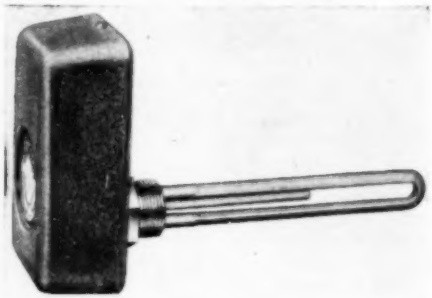
You may not get a clean break every time, and it's hard to nibble away sections that have broken too far from the score. Since the bottles cost nothing, badly cut ones are best thrown away. Even a well-cut edge has sharp corners. Dress these with a slow-turning abrasive wheel and water, or with emery paper. Wrap the paper around a stick and work over the edges. Then hold the mug upside down and rub with a rotary motion over a sheet of emery paper on a hard surface.

To give the tumblers a finishing touch, they should be wrapped with raffia or colored plastic cord. If raffia is used, give it a coat of waterproof varnish. END

Suction Opens Drawers

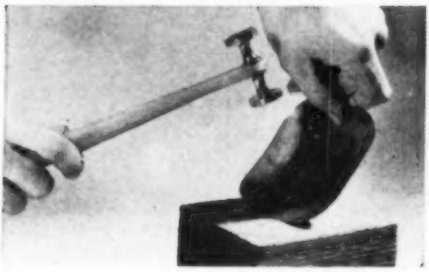
You probably know that helpless feeling when the pull comes off in your hand as you start to open a drawer. Next time that happens, don't chew up the edges of the drawer trying to pry it open with a screwdriver. The old reliable plumber's helper usually will do the job. Press it firmly against the drawer front and pull. Any marks left by the rubber can be polished off with a soft cloth.—*R. F. Donovan, Jersey City, N. J.*

Heater Has Thermostat



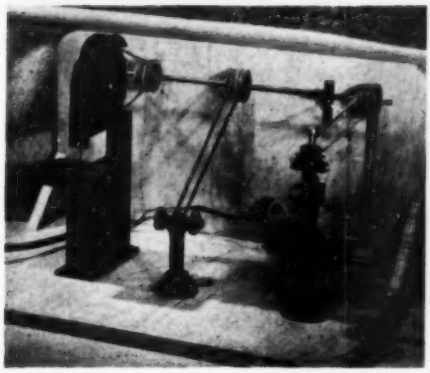
Designed for conversion of fuel-fired hot-water tanks to electricity, this screw-in type heater has a built-in thermostat for temperatures from 100 to 170 deg. F. The maker, Edwin L. Wiegand Co., Pittsburgh, recommends its use on the farm—in poultry and dairy buildings—and in summer cabins. Prices range from about $19 to $22, depending on the wattage—from 750 to 1500. It's available for 115 and 230 volts.

Cabinet Knobs Form Head of Craftwork Hammer

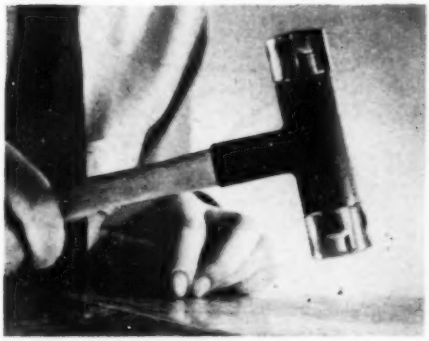


Two cabinet pulls, a bolt, and a handle are all the parts needed to make this light hammer. You'll find it useful in smoothing out the surface of soft metals. The handle may be whittled or turned on a lathe. Make it springy and about 10″ long. Then drill a hole in the handle the same size as the bolt used to mount the knobs. Cut the head off the bolt and push it halfway through the hole. Screw the knobs firmly to both ends of the bolt.—*M. D. Koehler, River Grove, Ill.*

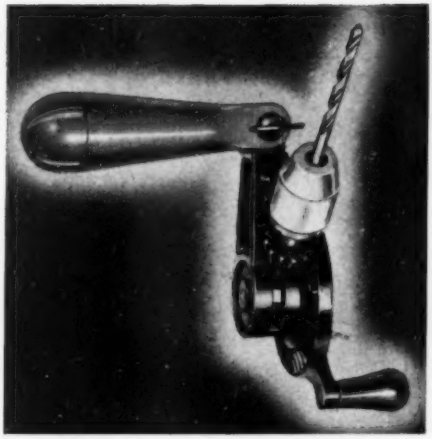
NEW TOOLS

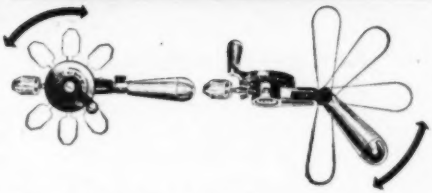


Workshop on a Table Top. Suitable for the modelmaker or plastic craftsman, these miniature power tools are made chiefly of Tenite® plastic. The bandsaw stands 10″ high and has a 3″ throat. Its steel blade (about .012″ thick) cuts either wood or plastics. The grinder, 3½″ high, comes with two fine grinding stones, but a sander or buffer can be substituted. The 7″ drill press uses jeweler's bits. Paulite Products, Galt, Ontario, makes the tools. Complete with 1/20-hp. motor, the set sells for about $20, plus U.S. duty.

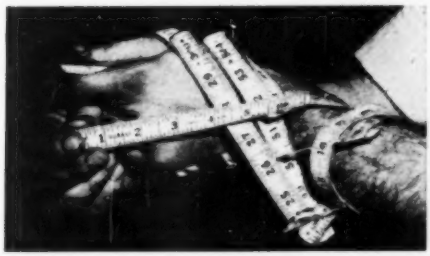


Hammer Doesn't Bounce. Steel grit packed loosely within the hollow steel head of this hammer absorbs the recoil when you strike a blow. The manufacturer claims this results in 30-percent harder blows. Replaceable plastic tips prevent marring of work surfaces. H. F. Soderling Co., Seattle, Wash., distributes the 1-lb. hammer.



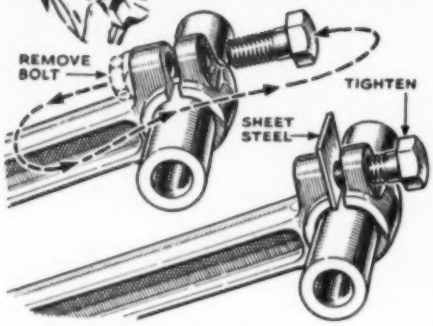


It Drills Around Corners. A hand drill made by the JO Manufacturing Co., of South Gate, Calif., can be adjusted to almost any position you want. As the sketch shows, the chuck swivels to any one of seven different positions. A strong spring catch locks it. The handle, secured by a knurled thumbscrew, swings in a 180-deg. arc at right angles to the movement of the chuck. The drill sells for about $4.



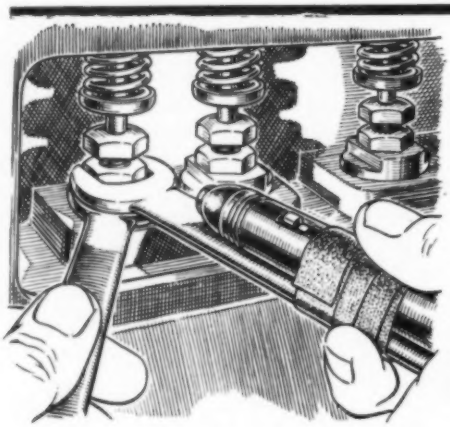
Folding Rule Also Bends. At first glance, you might think the above is a cloth tape measure. Actually, it's a 6′ folding rule. Made of flexible steel, the 3 1/5-oz. rule is completely rigid when extended, but can be bent as necessary for measurements that aren't in a straight line. Durall Tool Corp., Yonkers, N.Y., prices it at $1.

Hints from the Model Garage

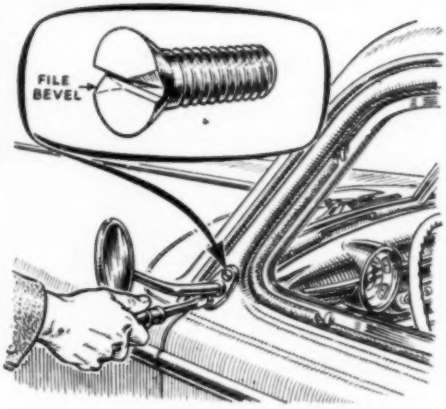


Con Rod Pressed Open. Wrist pins to be clamped in connecting rods of the kind shown will not always go in easily, even with the bolt loosened. If assembly proves difficult, reverse the bolt as shown and use it and a piece of thin steel to spring open the con rod very slightly. Replace the bolt in its proper position after doing this.

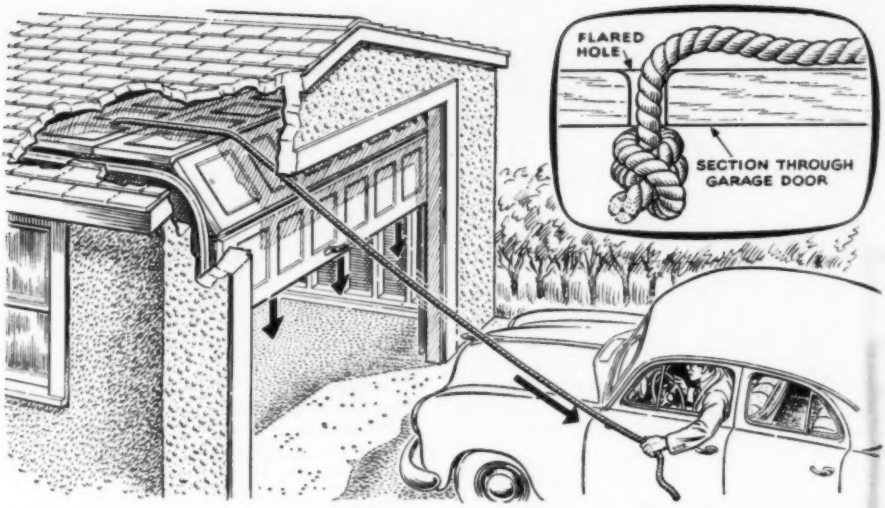
Coins Kept in Ash Tray. If you are a nonsmoker, the dashboard ash tray is a handy place to keep a supply of pennies, nickels, and dimes for parking meters and toll gates. For convenience in removing the coins, bend down the snuffer. Felt or cotton lining cemented to the bottom and sides will stop rattles.



Light on the Spot. Adjusting valve tappets on a car is a fussy job to do just right. What makes it troublesome is the necessity of manipulating wrenches and a thickness gauge in cramped quarters with inadequate light. Albert S. Eaton, of Belmont, Mass., reports that the work goes a little easier if you tape a pocket flashlight to the upper tappet wrench.



Filed Screws Prevent Theft. If you attach a mirror, road light, or other accessory with external screws, safeguard it against theft by filing off those corners of the slots that the screwdriver bears against during removal. Once tightened, the screw is next to impossible to remove, so use it only on permanent installations. You can retighten it, however, if vibration loosens it.



Rope Closes Overhead Door. With this arrangement, you don't have to get out of the car to close the door after leaving the garage. Just grab the rope dangling near the jamb, and give it a pull after you have backed out. Attach the rope (a clothesline will probably serve) by drilling a hole a few inches down from the top of the door. Charles Morse, Elmira, N. Y., says he finds the rope trick very convenient. For easy operation of the door, keep the rollers and track well lubricated.

Tire Cushions Towing Bumps. An old tire makes an excellent coupling to a car that you want to tow. Pass a few turns of heavy wire or rope around the tire and the respective bumpers of the two cars and you are ready to go. The tire effectively smooths out the jerks and nicely cushions the bumps in stopping, writes Leslie H. Housel, of Grass Lake, Mich.

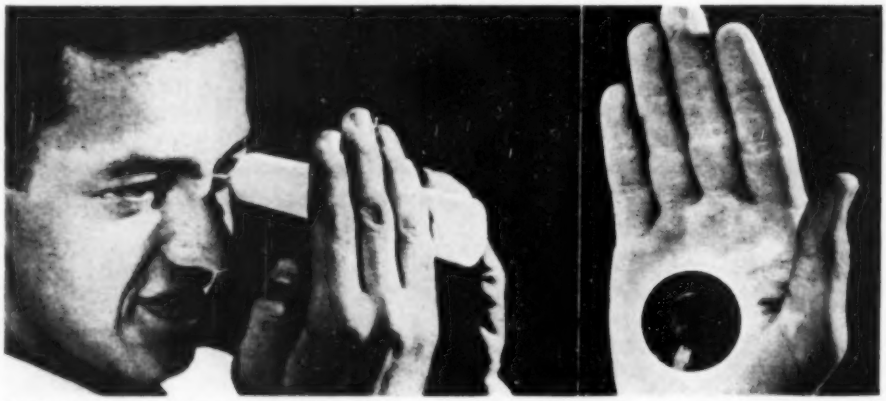
Corrosion Knocks Out Lights. If either beam of a sealed-reflector headlight goes out, be sure you really need a new unit before putting down the cash. In some cases, particularly in older cars, you will find the contacts have become so corroded that the resistance prevents the lamp from lighting. Careful cleaning of the contacts will restore the light to usefulness.

You Can't Believe Your Eyes

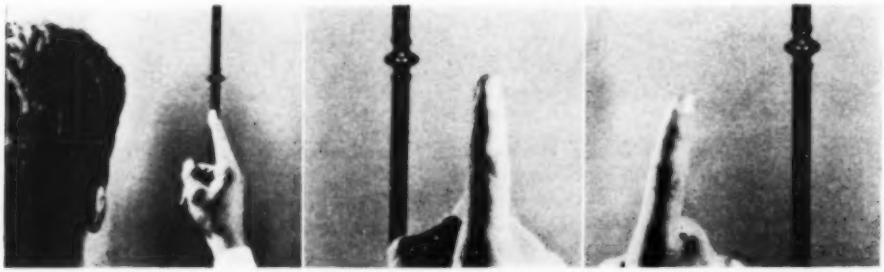
THERE'S more truth than you may think in this old saying. Usually, human eyes do an amazingly good job—but they can be tricked. Through optical illusion, you may seem to see things you actually don't see.

Here are some examples. Try them. And remember them the next time you are tempted to be the life of the party.

Make an extra finger. Bring your index fingers together at arm's length, focusing on the fingertips. Then look beyond at a distant wall. You will seem to see a short, two-ended finger.



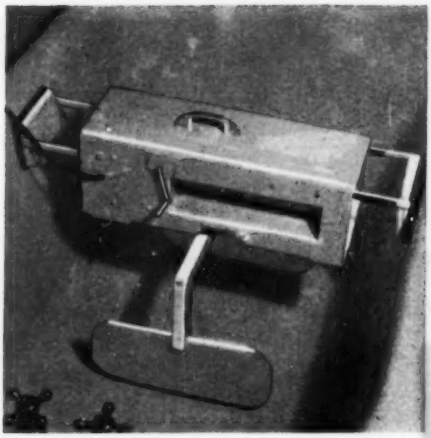
Look through your hand. Roll a sheet of paper into a tube about 1" in dia. Look through it with your left eye, and at your hand, held beside it, with the other. You seem to look through the hand. Your mind superimposes the image seen by one eye on that seen by the other.



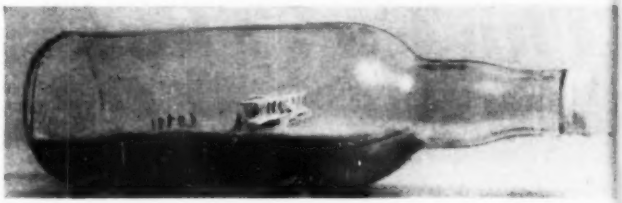
Are you right-eyed? Just as you are right- or left-handed, you are also right- or left-eyed. Which are you? Point at an object with both eyes open (left). Close your right eye. If the finger jumps right (center), you are right-eyed. If it doesn't, you are left-eyed. Check by opening the right, closing the left. If it jumps left, you are definitely left-eyed.

CRAFTSMEN AT WORK

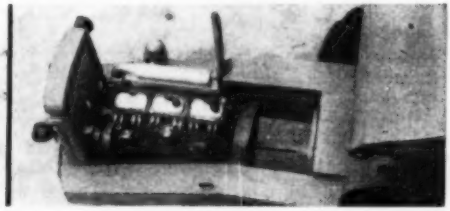
Builds Wireless Mike. Following plans published on these pages (PS, Nov. '48, p. 224), Paul Hertzberg, of Jackson Heights, N. Y., assembled this wireless microphone. He substituted a phono-oscillator coil for the adjustable iron-core oscillator coil described in the article. He reports excellent results with a secondhand crystal mike cartridge and a 2′ antenna. The plastic case is a surplus battery box.



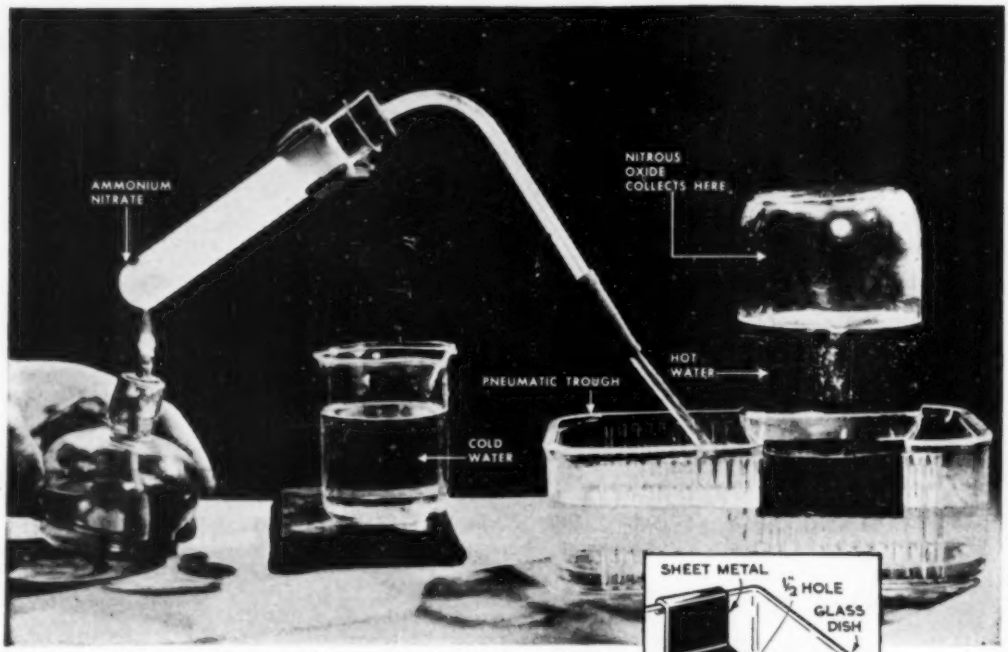
Clothes Washer Fits Tub. This portable electric washing machine—built by Irvin D. Tice, of Salem, O.—is powered by a 1/10-hp. motor. Although only 6″ high and 16″ long, it includes a small wringer and handles 5 lb. of wash. To hold it in a bathtub, arms are pulled out from the ends and locked against the tub sides. The agitators that wash the clothes fold against the bottom when not in use.

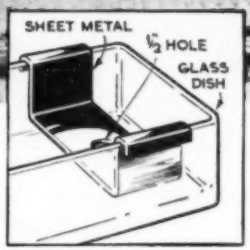


Bottled Plane. A PS article on ships in bottles by the late Capt. E. Armitage McCann suggested this treatment of the Wright brothers' famous Kitty Hawk. Conant H. Emmons, of Washington, D. C., built the model to a scale of 1/16″ to 1′. The sand-colored putty went in first. Then the fuselage on the launching rail was inserted. Next came wings and elevator. Last to go in was the figure of the man at the wing tip.



Earth Mover Modeled. John F. Mills, of Toccoa, Ga., spent more than 500 hours building this model of a LeTourneau tractor and earth scraper. Only scrap metal and wood were used in the project. Every visible detail of the prototype is duplicated in the model. All moving parts operate except the dummy Diesel engine.





Nitrous oxide, or "laughing gas," is produced with this apparatus. You can assemble a pneumatic trough as shown in drawing at right.

The Gas That Makes You Laugh

Chemists call it nitrous oxide. You can generate this and other oxides of nitrogen in a home laboratory.

By Kenneth M. Swezey

AN ACHING tooth is never funny. But the dentist who yanks it out may well first put you to sleep with a few whiffs of nitrous oxide, commonly known as "laughing gas."

Joseph Priestley discovered this colorless gas with the sweetish odor in 1772. A quarter of a century later, Humphrey Davy, another famous English scientist, found that if mixed with a certain amount of oxygen the gas produced a feeling of exhilaration when inhaled. Hence, its name.

Long used as an anesthetic for dental work and minor surgery, nitrous oxide (N_2O) is one of five known oxides of nitrogen. The others are nitric oxide (NO), nitrogen trioxide (N_2O_3), nitrogen pentoxide (N_2O_5), and nitrogen peroxide. The latter takes two molecular forms, nitrogen dioxide (NO_2) or nitrogen tetroxide (N_2O_4).

Nitrous oxide is still prepared today by the same method that Davy employed—by carefully heating ammonium nitrate. At about 200 deg. C., this compound breaks down into nitrous oxide and water vapor. You can do this in a home laboratory.

But before you begin, here's a word of caution. Like all nitrogen compounds, ammonium nitrate is comparatively unstable. An explosion may occur if it is mixed with other substances, if it contains impurities, or if it is overheated when confined.

However, it has been heated in laboratories and chemical plants for 150 years

without accident save through carelessness. If you follow the rules, as all chemists should teach themselves to do, you will have no trouble.

Begin by putting about 10 grams of chemically pure ammonium nitrate into a large test tube fitted with a one-hole stopper through which passes a bent delivery tube. Clamp the test tube to a ring stand at a 45-deg. angle. Connect the delivery tube to another bent glass tube leading into a pneumatic trough.

Pour water into the trough to a level just above the shelf. Also fill the collecting bottle to the brim with water, cover its mouth temporarily with a piece of cardboard, and invert it on the shelf. Since nitrous oxide is fairly soluble in cold water, use water as hot as possible in the trough and bottle.

Place a large beaker of cold water near your apparatus. The end of the test tube may be immersed in this if the reaction should become too rapid.

When you're all set, begin production of the gas by *gently* heating the ammonium nitrate with an alcohol lamp or with the flame of a Bunsen burner turned low. Keep the lamp or burner in your hand and move the flame constantly to distribute the heat. Give all your attention to the job.

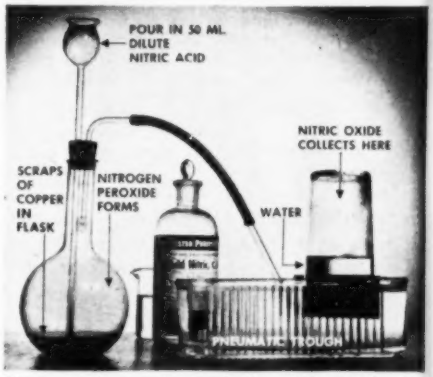
At first the nitrate melts slowly. Further heating causes it to break down into a mixture of nitrous oxide and water—a white vapor. The reaction itself produces heat. So apply the flame at this point just enough to keep the reaction going. The speed can be determined by observing the bubbles of gas entering the jar. Don't let them exceed one or two a second.

When the jar is full of gas, remove the heat from the test tube, and immediately disconnect the delivery tube to prevent water from being drawn into the test tube as it cools. Then slide a sheet of cardboard or glass under the mouth of the jar and stand it upright for your tests.

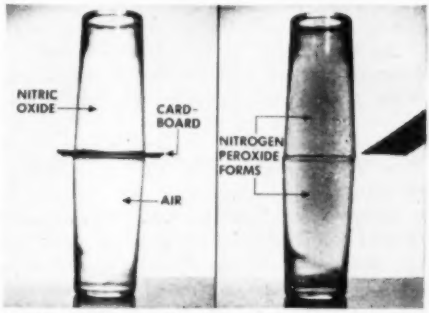
(As a final safety precaution, don't try to decompose the last gram or so of ammonium nitrate in the test tube. This small amount may easily become overheated.)

When nitrous oxide itself is heated strongly, it decomposes in turn, forming nitrogen and oxygen and giving off considerable heat. The oxygen in nitrous oxide is more concentrated than it is in normal air. Hence, many substances that already are burning will burn as brightly in this gas as they do in pure oxygen. As a demonstra-

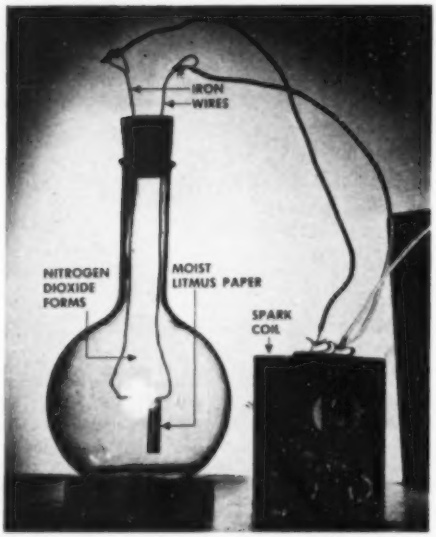
Steel wool will burn—if encouraged. Attach a pad of it to an iron wire, put a little burning sulphur on the wool, and lower into a jar filled with nitrous oxide as shown above.



Nitric oxide can be made like this. If the reaction slows before jar fills with gas, pour a little concentrated nitric acid into tube.



Nitric oxide is colorless. But if mixed with air, as seen here, it quickly turns into nitrogen peroxide, a reddish-brown, poisonous gas. Be very careful to avoid breathing any of it.



Oxides of nitrogen for use in making fertilizers and other products once were made on a large scale this way. Here, blue litmus paper turns pink, showing nitric acid is present.

tion, try the steel-wool experiment shown on page 237.

Most stable of the oxides of nitrogen is nitric oxide, another colorless gas. It contains twice as much oxygen as nitrous oxide, but it holds onto its oxygen more tenaciously. Burning sulphur thrust into a bottle of it will immediately be extinguished.

Nitric oxide can be made with the setup shown on the preceding page. When you pour in the dilute nitric acid (1 part acid to 2 parts water), nitric oxide will be liberated. At the same time, the flask will fill with a reddish-brown vapor. This is nitrogen peroxide, produced by the reaction of some of the nitric oxide with oxygen from the air. This colored gas will dissolve in the water in the trough, and the collecting bottle will fill with colorless nitric oxide.

A striking property of nitric oxide is that it always changes immediately to nitrogen peroxide upon exposure to air. Cover a tumbler or jar of nitric oxide with a piece of cardboard and invert it over a similar tumbler or jar of air. While the partition remains, each gas is colorless. But remove the partition and the heavier nitric oxide in the upper jar will flow downward. On mixing with the air, it changes at once into brown nitrogen peroxide.

At room temperature, nitrogen peroxide is a mixture of nitrogen dioxide and nitrogen tetroxide. These gases are chemically the same, but nitrogen tetroxide (N_2O_4) has molecules twice as big as nitrogen dioxide (NO_2).

Temperature affects the relative amounts of the two gases in the mixture. Below 20 deg. C., each molecule of NO_2 unites with another one, forming N_2O_4. As the temperature rises, the big molecules begin splitting in half. At 154 deg. C., all have become NO_2.

Nitrogen tetroxide is colorless; nitrogen dioxide is brown. You can show the transformation by filling two test tubes with nitrogen peroxide. Heat one and the gas in it will darken as more NO_2 forms.

To prepare nitrogen peroxide directly, merely add concentrated nitric acid to some bits of copper in a large test tube. Stopper the tube quickly with a one-hole stopper fitted with a glass delivery tube. Lead the delivery tube to the bottom of another test tube or similar container. The nitrogen peroxide will then displace the air.

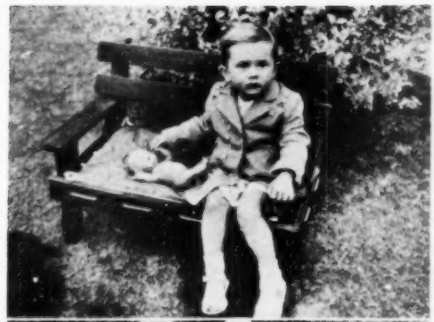
Nitrogen peroxide is very poisonous. So make it in a well-ventilated room.

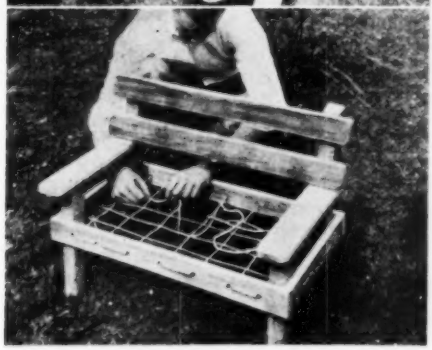
The most important reaction of nitrogen peroxide is with water. The gas dissolves readily in water, reacting with it to form both nitric and nitrous acids. In warm water, the nitrous acid decomposes, leaving nitric acid.

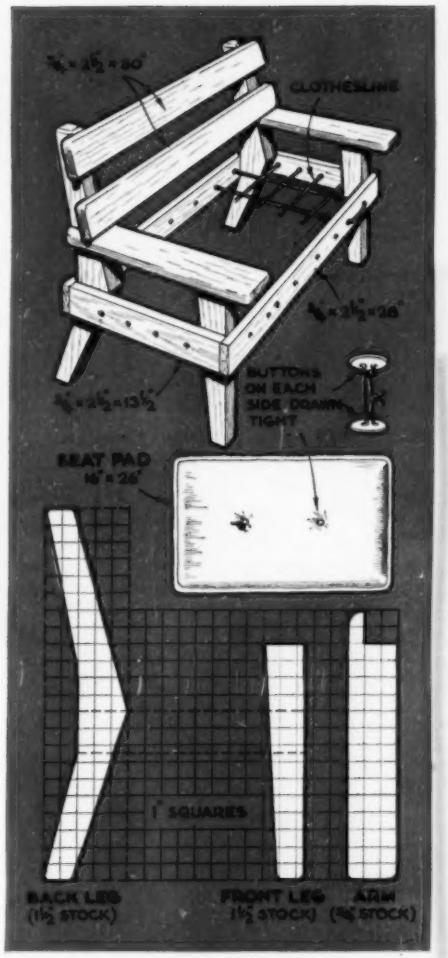
At the beginning of this century, great quantities of nitric acid, and subsequently nitrogen compounds for fertilizers and other uses, were made from nitrogen oxides obtained by passing ordinary air through the heat of an electric arc. The heat of the arc caused some of the nitrogen and oxygen of the air to unite, forming nitric oxide. Cooled and passed through more air, this united further with oxygen, giving nitrogen dioxide. This, in turn, was dissolved in water to form nitric acid.

You can duplicate the process on a small scale with the apparatus shown at the top of this page. Bend the lower ends of the stiff iron wires so they form a spark gap with about ½″ between the points. Hang a moist strip of blue litmus paper over one.

Connect the two wires to the high-voltage terminals of the spark coil. Let the spark jump the gap continuously for several minutes. The spark produces nitrogen dioxide. This in turn reacts with the moisture in the litmus paper. The litmus turns pink, indicating nitric acid has formed. END







Canvas Pad Cushions Children's Lawn Seat

EVEN the most active child likes to rest occasionally. Placed with your regular lawn furniture, this little bench will give youngsters a happy sense of importance in having a seat all their own.

Any wood you have on hand can be used. Lay out the legs with the grain on 1½" stock. Use ¾" stock for other frame members. Sand all of the surfaces smooth and round the corners. Assemble with waterproof glue and finishing nails, set and filled over with putty. Paint to suit other lawn furniture.

Laced clothesline supports a canvas seat pad. Set two buttons in the pad as shown, stuff with cotton batting, and secure the edges with ⅜" binding tape.

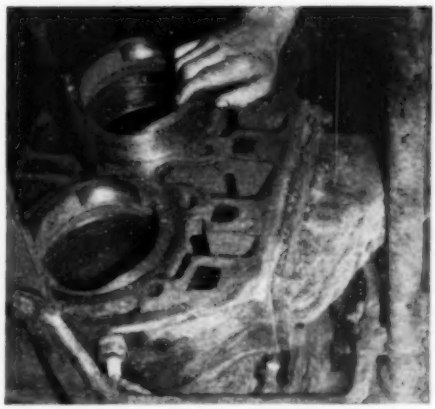
Made to larger dimensions, the seat will give grownups a place to rest on summer days.—*Dick Hutchinson, Alhambra, Calif.*

Lipstick Makes Red Candles

HERE'S a tip for homemakers who like to melt down old candle stubs and mold the wax into new candles. A lipstick provides an ideal way of coloring the new candles a deep red for use on festive occasions. This also has the advantage of putting lipstick odds and ends to good use. After the old candles have been melted down, shave the lipstick into the solution.

Four Wheels Drive Tractor

A MAXIMUM amount of traction is delivered through the four chain-driven wheels of this tractor manufactured by the Detroit Tractor Corp., Detroit, Mich. Steering levers control self-energizing brakes on each side of the differential to retard wheel rotation and turn the machine. The power plant is a 4-cylinder, 16-hp. engine. Tire sizes are 6.00 by 16, or 7.50 by 16 at extra cost. Two models are available, one with magneto ignition and the other with self-starter, generator, battery, and lights. Weighing 1,600 lb., the tractor is 78″ long.



Inserts Raise Compression

WITHOUT changing any of the standard parts of a tractor, these inserts increase engine compression, giving it more power. Made by the Hi-Compression Products Co., Washington, Ia., the inserts fit into the cylinder tops. This cuts down the space in the combustion chamber and increases the compression. The company says the inserts maintain the balance of the engine and also direct the explosion toward the center of the piston, reducing blow-by action. Inserts are made for John Deere, Allis-Chalmers, and International Harvester Co. tractors.

Sweeper Cleans Lawns

POWERED by a 4-cycle gasoline engine, this rotary power sweeper offered by the Modern Manufacturing Co., Pasadena, Calif., can be set to sweep parking lots or streets as well as lawns. The only control is the large guiding handle that governs both movement and direction. Pushing the handle forward sends the unit ahead. Dropping the handle stops the sweeper. It's available in two sizes, sweeping 36″ and 48″ paths.

Trailer Has Double Hitch

A FEATURE of the Wheel-O-Matic® trailer, built by the Sedgwick Machine Works, Poughkeepsie, N.Y., is the double hitch. It facilitates parking and prevents jacknifing. The floating wheel assembly eliminates shimmy, enabling the trailer to carry a 1,000-lb. load at speeds up to 65 m.p.h. It tips the scale at 300 lb., is 12″ deep, 42″ wide, and 60″ long. Equipment includes couplings and emergency chains.

Leads to "double reward" in color

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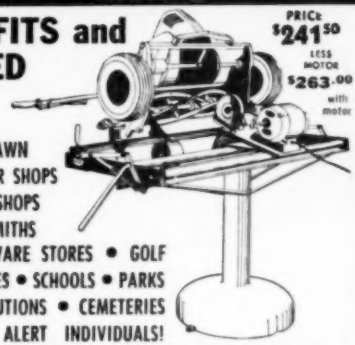

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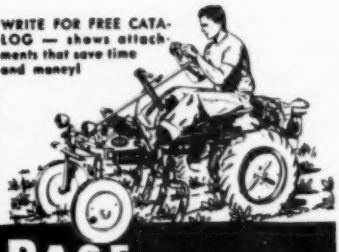

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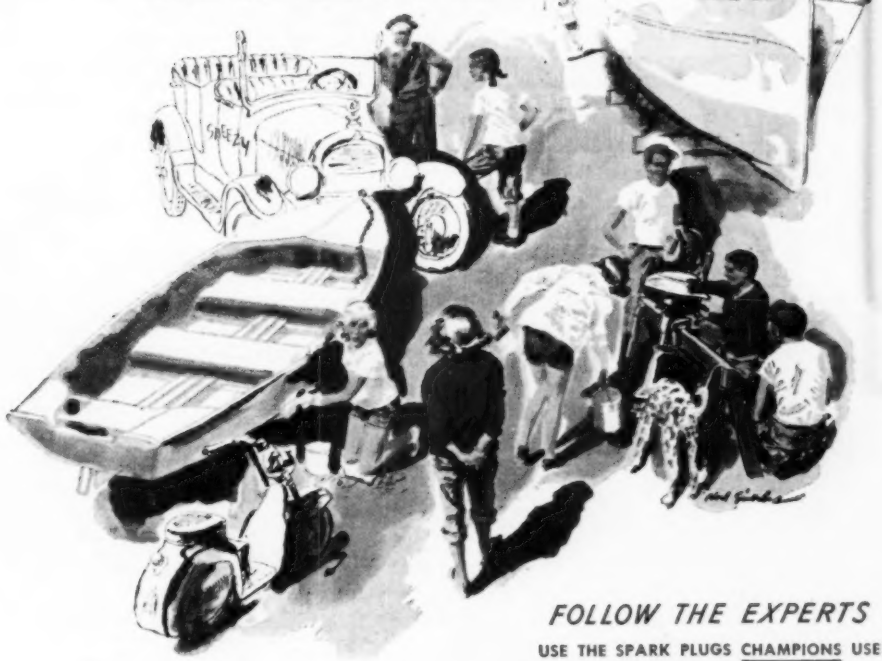

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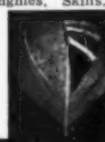
1949 line features many new models offering increased performance and greatly simplified instructions. Low prices! 8 ft. Dinghy $34.50, 16 ft. Runabout $159. Dinghies, Skiffs, fishing and speed boats for the home builder.



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100 designs by Deed, Lord, Crandall, etc., plank, steel, and plywood types 6-35 ft. Detailed blueprints, full-size paper patterns. **Catalog 35c (coin). Catalog and booklet "Boat Building" $1.00.**

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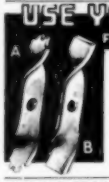

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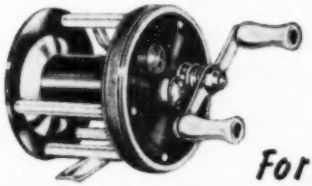
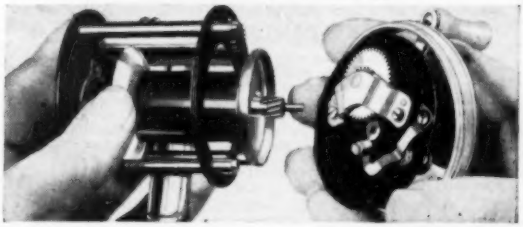


New Heddon "Pal" Reel

with removable head ring



For smoother, longer casts

Light tackle enthusiasts like this new Heddon "Pal" Reel because its light, sturdy construction assures smoother, longer casts. (Takes 100 yds. 12½ lb. line.) Its patented new head ring unscrews by hand. Head and spool pull out without disturbing adjustments, or losing parts. This permits better cleaning, oiling and assures the free, effortless operation of this fine, precision reel. Write for new catalog on Heddon Rods, Reels, Baits, Fishing Tips. It is the most interesting one we have ever published.

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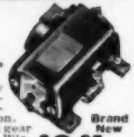

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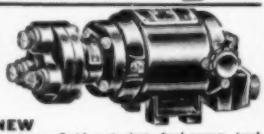

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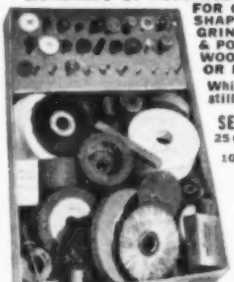

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3 Honing stones
2 Felt bobs
10 Sanding rolls
6 Sanding sleeves
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1 ⅞" rubber wheel on ⅛" mandrel
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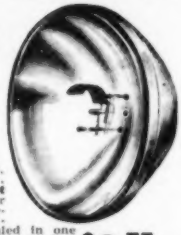

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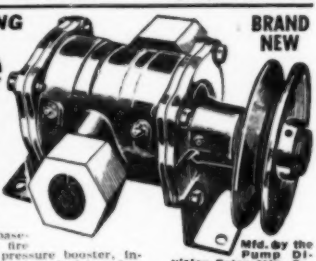

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Pressures up to 150 lbs. to 14 gallons per minute—1500 R.P.M. Will not rust, pit, foul, or freeze up. Use rubber hose inlet, pipe or tubing outlet. Equipped with ½" standard pipe thread port. Weight 10 lbs. Standard 1" manganese bronze shaft with keyway. **U.S. Gov't. Acquisition Cost $62.00.**

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For pneumatic tools, filling hi-pressure vessels, paint spraying, insecticide vaporizing and other uses.

Rated 450 P.S.I. at 1200 R.P.M. Used on Packard Merlin Engine, this aluminum air pump with air filter intake weighs only 41½ lbs. 9" x 5" x 31½". **Gov't. Acq. Cost $185.00.....NOW ONLY** **$15.00** post paid

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complete with mounting kit ready to install

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BRAND NEW . . . for operating hydraulic cylinders and hydraulic motors on tractors, bulldozers, construction machinery, lift trucks, industrial applications, etc. Delivers 8 GPM at 1200 RPM at 1000 P.S.I. using 3 H.P. Has ½" pipe thread inlet, ⅜" pipe thread outlet. ¾" shaft with flat and keyway for direct or pulley drive. Has flange with 4 bolt holes for convenient mounting. Ship. wt. 22 lbs. Overall dimen.: 7" L x 5½" H x 5½" W. A $105.00 value . . . FOR ONLY ..... **$22.50** F.O.B. Chicago

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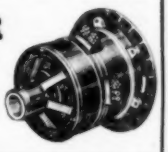

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PUMPS RATED 500 GALLONS PER MINUTE AT 275 FT. HEAD PRESSURE.

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1. Four-way control valve for use with double action hydraulic cylinder, may be used with 1500 P.S.I. hydraulic system to open and close hydraulic cylinders. Brand new. Ship. wt. 4 lbs. A $38.00 value ..... postpaid **$7.95**

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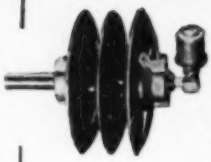

Illustration showing application on Bandsaw

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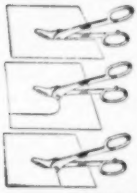

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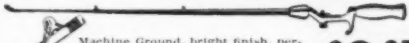

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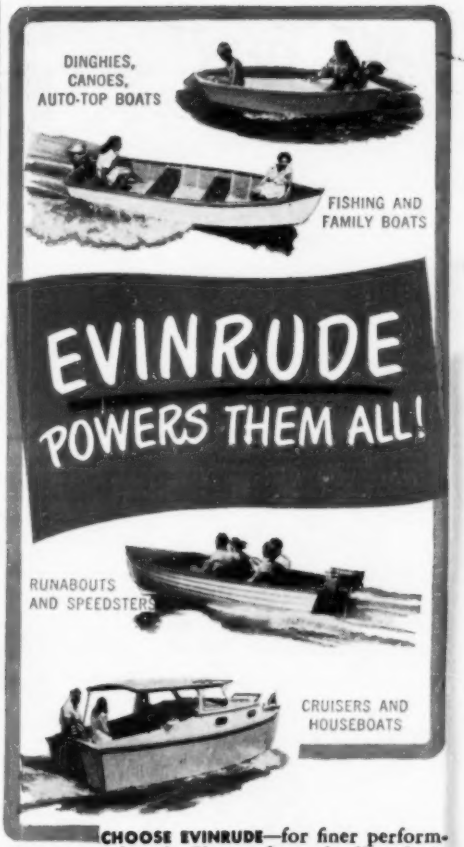

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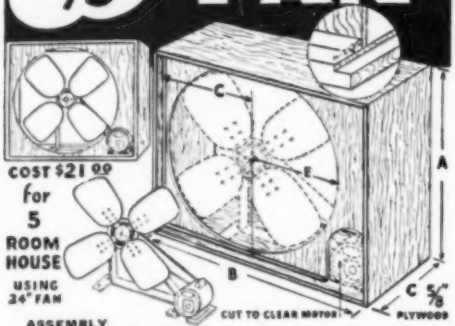

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Size Fan	Dim -A-	Dim -B-	Dim -C-	Dim -E-	Price
20"	22"	29½"	11"	10½"	$19.50
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26"	28"	34½"	14"	13½"	$22.00
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700-20(8)	9.29	1100-20	13.89	750-16	8.40
700-20		1200-20	18.78	900-16	8.98
(10)	12.48	750-24		825-15	
750-20(8)	8.19	(36-6)	12.21	(14 ply)	14.10
750-20		38-7		750-15	
(10)	9.19	(825-24)	13.75	(12 ply)	11.30
		1000-22	17.70		

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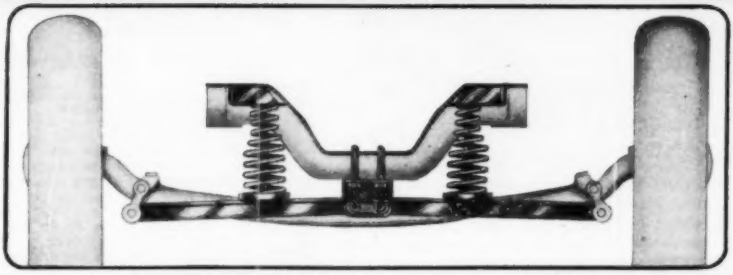
Front Coil Spring Assembly

Makes '35 to '48 Fords, Mercurys Ride Like a 1949!



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Mr. J. Patton, M.E., for one of the largest steel fabricators in the country, did the mechanical engineering on the Front Coil Spring Assembly for Fords and Mercurys, and supervised tests of component parts. Additional experiments were made in the engineering laboratories of two of America's prominent spring and forging manufacturers. Mr. Wayne Hart, Ford Agency Superintendent at Idabel, Oklahoma, says: "For over a year, on 'washboard' roads and the worst highways in the State, I tested your new Front Coil Spring Assembly on a Mercury for thousands of miles under actual driving conditions. It does not affect steering or wheel-alignment; it does not cause car 'sway' at high speed or on curves. The steel forgings are made of identically the *same type of material as used in the Ford front axle.* The unit is as *strong, safe, and durable as the original* equipment. When the wheels get a sharp blow from hitting a bump or rut, the Coil Springs absorb the jolt and cradle the force of the bounce to a gentle glide."

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MY NAME IS .....

MY ADDRESS IS .....

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NOTE

NOTE! AGENTS WANTED! For details on BIG profit-making deal—check ☐ Also check if you are a Retailer ☐ or Wholesaler ☐

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read page 74, April issue

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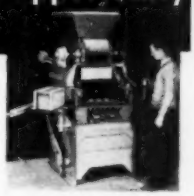
Amaze your friends! Make money spray-painting cars. It's easy with our simple, reliable MASTER MECHANIC outfit. Follow simple directions. PROFIT from first job or two pays for entire outfit. Same equipment paints houses, barns, sprays orchards, weeds, insecticides, inflates tires, greases machinery. WRITE for details and sensational low price.

MASTER MECHANIC CO., Dept. 14, Burlington, Wis.

A Manufacturing Opportunity Open to YOU!



Your big years are right ahead! You can tie in with the great building industry, yet develop your own business manufacturing concrete block, drain tile, brick, roof tile, etc. We'll start you right in the

Modern Masonry Products

business and help you put it over. We supply complete equipment, built and developed through forty years of dealing with men like you. Helps you build for local market, using local materials and labor. High income potentials. Our line of modern machinery enables you to start small and grow big.

Write for catalog. Gives prices and full information.

CONCRETE EQUIPMENT CO.
510 Ottawa Ave., Holland, Mich.

SHARPEN CIRCULAR SAWS LIKE AN EXPERT

$6.95

Precision file circular saws in your own workshop. No experience necessary. Two simple adjustments. Gets hollow ground, cross-cut or combination saw blades true and sharp. Fits 6" to 12" blades with ½" to 13/16" centers. Includes file and complete instructions. $6.95 postpaid—check or money order. $1.00 deposit on C.O.D.s. Guaranteed, money back if not satisfied after ten days trial. At your dealers or order direct.

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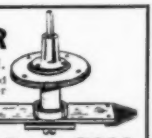
Make Your Own

POWER LAWN MOWER

with this DRIVE CUTTER ASSEMBLEE.

Constructed for those who desire to build their own mower or to replace your old cutter assemblee. Complete with 18" blade and double ball bearing drive. Add 50c to cover handling & shipping. No COD's.



only $11.95

ATLAS EQUIPMENT CO., Dept. PS6A
229 S W BLVD. KANSAS CITY, MO.

AUTOMATIC RETOOTHER

MAKES NEW **PROFITS** for **HAND SAWS**

Cuts new teeth in 50 seconds — any size 4 to 16 points. Old teeth fall off as chips. Easy to operate. A perfect job.

IMMEDIATE DELIVERY

BURR MFG. CO.
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VALUABLE BOOK
Order Burr's Blue Book of Coast to Coast prices for saw shop services. **25c**

REMODEL YOUR HOME!

. . . WITH THE WESTERN PINES

Build a bunk bedroom for your youngsters, or a rumpus room . . . panel your halls and walls . . . build in kitchen and dining alcoves, with the easy-to-work, lovely-to-look-at Western Pines. Turn idle spaces into trim, tidy dens, closets and compartments. Enjoy workshop hours making tables, cabinets, bookcases, bric-a-brac.

The charm's in the wood, and it's a joy to work with lumber that's **naturally** tasteful and rich. Soft, straight-grained, luxurious; grips paint or looks beautiful in its natural splendor. Send coupon for Idea Packet No. 209 to see what these wondrous woods can do for your home.

These are the Western Pines
★ IDAHO WHITE PINE
★ PONDEROSA PINE
★ SUGAR PINE

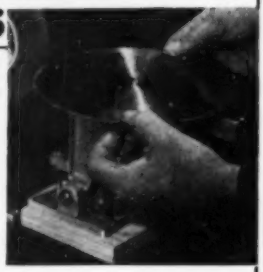
CLIP THIS COUPON TODAY!

WESTERN PINE ASSOCIATION, *Dept. 209-L*
Yeon Building, Portland 4, Oregon

Please send me your IDEA PACKET No. 209 containing interesting booklets and folders about the Western Pines—"Western Pine Camera Views," a book of building and remodeling ideas—"How to Treat Knotty Pine Paneled Walls"—"Bunk Bedroom Details."

Name _____
Address _____
City _____ *State* _____

Sharpen Saws Yourself With TREYCO FIXTURES



Saws require setting only once to 5 or 6 sharpenings. Assures faster, cleaner cuts. Furnished complete with saw set and all accessories for all saws. Save money and earn extra money by sharpening saws for yourself and others. Tool makers precision . . . low prices . . . order by model numbers below . . . send check or money order . . . money-back satisfaction guarantee . . . shipped prepaid.

Model No.	Saw Size	Price	Model No.
280	7" - 8"	$11.95	280W
100	7" - 10"	$14.95	100W
120	7" - 12"	$16.95	120W

$5 extra for 2 grinding wheels

BY POPULAR DEMAND—MODEL 130 NOW AVAILABLE FOR SHARPENING SAWS FROM 2" to 12" IN DIAMETER. Only Saw Sharpening device of its kind. Used by America's leading plants. Precision built for accurate work. Sharpens all types of circular saws. Model 130 only $23.50. Model 130W including 2 grinding wheels only $28.50.

Specify your grinding wheel hole size.

Quickly Easily PAYS *for* ITSELF

TREYCO PRODUCTS
264 HARTFORD AVE. DEPT. PS6 BUFFALO 17, N. Y.

POWERFUL, LIGHTWEIGHT *Mustang*

Has all the snap of a big motorcycle at half the price

Excellent workmanship and design includes

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COMPLETE RIDER CONTROL

ECONOMICAL • MANEUVERABLE

Ask your local dealer about the sensational new Mustang, or write for illustrated folder.

ORDER NOW FOR IMMEDIATE DELIVERY

A few choice dealerships still open

MUSTANG MOTORCYCLE CORPORATION
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Easy and Cheap to Operate

SAVE TIME, WORK, MONEY!

SHAW "DU-ALL" and "PEPPY PAL" TRACTORS

PLOW

CULTIVATE

MOW

RIDE

These rugged walking or riding tractors ideal for farm, truck garden, orchard, poultry farm. They operate on a few cents an hour. A child can handle them.

DO DOZENS OF JOBS

The Shaw Du-All or Peppy-Pal does many jobs quickly and easily. Plows, cultivates, harrows, disks, bulldozes, sprays, hauls, grinds, and saws wood.

BUILT FOR RUGGED WORK

Sturdy, extra-strength construction means low upkeep, long life. Full year's guarantee.

LOW FACTORY PRICES

Buy direct or through your dealer! Almost anyone who owns a garden can afford a Shaw Du-All or Peppy Pal. Mass production holds prices down —quality up.

RIDING TRACTORS

4 models, from 5 to 12½ H. P., 58 in. wheelbase, 36 in. wide, 24 in. plant clearance. Hand or electric starter. Improved steering device, brakes enclosed in differential housing. Heavier frame and bearings. Standard hitch for trailers and wagons. Plow, harrow, cultivator, cutter bar, snow plow, bulldozer available.

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SHOP SMITH MULTI PURPOSE POWER TOOL

REG. TRADE MARK

Magna Engineering Corporation
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WOOD CARVING

9" TALL FIGURINE Postpaid in U.S.A. **$1.85**

This beauty is easily carved in white pine with a mahogany and velvet base. Complete kit includes Material, Tru-Form templates and instructions. For more new and unusual projects send 10c for latest catalog.

BRAUN-CRAFT 1232 ETOWAH, DEPT. PS-19 ROYAL OAK, MICHIGAN

★ SAVE TIME and MONEY *with the* **MARCLIFF Saw ARBOR**

• DEALERS WANTED

GUARANTEED ACCURACY

Built for service. Inner collar assembled to shaft. Then faced after assembly to INSURE ACCURACY. Bearing spots ground to .0003. Fabricated from Seamless Steel tubing. Top quality bearings for smooth operation. Available in ½" or ⅝" Shaft sizes. Size Housing 8" overall length 11½. Pulley end 1½".

SEND **$7.20** Check or Money Order Shipped prepaid

MARCLIFF MFG. CO., Hudsonville, Michigan

SAVE TIME AND $$$ WITH "MAGIC BUBBLE MITT"

Give your car that "New Look." Wash spot and streak free in ten minutes with Magic Bubble Mitt and Pellets. Mitt contains special pocket for pellets. Ends rubbing and scratching. Made of genuine lambs wool. No buckets, soap, chamois or wet clothes. See your dealer or write direct to us.

Magic Bubble Mitt and Twelve Pellets $1.20

HANDY POLISHING SET

Fits all std elect. drills. Polish or sand flat & curved surfaces. Incl. adapter, rubber backer, abrasive disc, and lambs wool bonnet to polish or buff . . **$3.00**

PIT-BAR MFG. CO. CREATORS OF QUALITY LAMBS WOOL PRODUCTS
3207 East 45th Street, Los Angeles 11, California

Here are Real WAR SURPLUS BARGAINS!

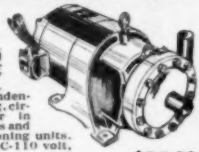
Hydraulic BUMPER JACK

Mfg. by Rausch Industries. H.B. 15, 1½ ton cap. Lifts all passenger cars. Collapsed height 30½", hydraulic 18". Saddle adjustment, low 3¾", high 17⅝". **Stock #334.** List $9.95.
Our price **$5.95**
(Lots of 6) **$4.95**

PLASTIC HOSE

Good for water, oil, air, electrical installations & radio work. Available in 100 ft. lengths. Min. order 50'.
⅛", 3/16", ¼" (your choice) per ft.... 2c
5/16" per ft..... 3c
9/16" per ft..... 4c
¾", 1", (your choice), per ft..... 6c
1⅜", per ft..... 8c

CENTRIFUGAL PUMP

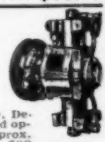


1" intake and outlet. Drip proof motor. (Master). 10 gal. per min. at a 48' head to 45 gal. per min. at a 20' head. 13 ft. lift. Ideal for condensate, sprinkling, circulating water in cooling systems and for air conditioning units. **Stock #532.** AC-110 volt. Mfg. price ½ hp unit $110.00 our price..... **$75.00**
AC-110 volt. Mfg. price ½ hp unit $120.00 our price..... **$80.00**

BALL BEARING ARBORS

Grinding and saw arbor, has ½" double end shaft, 11½" long with 2" center pulley. New Departure double roll ball bearings. Right and left hand thread. Self aligning Dodge pillow block. 10,000 RPM. Bearings alone list at $10. Complete arbor new.
Stock #305 ..... only **$4.95**
HI-SPEED GRINDER (not pictured). Has 3 step pulley driven thru rear or base. **Stock #328** **$10.95**

Westinghouse AIR COMPRESSOR



Brand new piston type, 2 cyl. compressor with automatic clutch. Westinghouse model T-1. Can be run off power takeoff or ½ HP motor. Delivers "oil free" air. Suggested operating pressure, 75 P.S.I. Approx. displacement 3.27 c.f.m. at 600 RPM. Ideal for spraying, industrial work, tire inflation, painting, etc. Approximate weight 23 lbs. **Stock #343. Only** **$22.50**

AIR TANK

10 gal. air tank 8" x 42", ¾" opening each end. **Stock #535.** Our price **$8.75**
With legs and saddle **$11.95**

HOSE 20' LENGTHS

Gas, oil or water resistant. Neoprene treated 1½". Male & female brass connectors. Standard filling station size. Value $20.00. **Stock #528.** Our price..... **$7.50**
Foot valve..... **$3.00**

SWIMMING OR BATHING POOL

Made of heavy glass cloth with rubber impregnated on both sides 12' diameter, 5' high, 3000 gal. cap. Ideal for: small irrigation project, swimming pool, animal watering. Complete with cover & guide lines. **$79.50**
Gov. price approx. $350. Our price
Due to handling remit full amount

ELECTRIC RUBBER CABLE (all new) CORD SETS

Extension cords 100 ft. Heavy duty. Plug, socket and guard. No. 16 wire. Worth at least $10.00. **Stock #310.** **$5.95**
Our price .....
Lots of 12 ..... **$4.45**
Same as above 50' lengths **$4.25**
Lots of 12 ..... **$3.15**

HEAVY DUTY ELECTRIC CABLE

3 wire #10 Super cable. **Stock #351.** 65' with lugs. Value $26.00.
Our price **$13.00**

DEADLINE FLASH

New Tool Post Grinder AC-DC. 7000 R.P.M. 110 volt. Ideal Electric Manufacturing Co. Type GHX. Weight 18 pounds. Two external, one internal grinding wheels and steady rest. Value $65.00. Price **$39.95**
Write for circular.

Horns and Howlers

Motor driven. (not a vibrator). Heavy duty with great power and long life. Adjustable for high, medium or low tone. 110 volt AC current. Weather proof. For alarm or signal horn on boats, school yards, factories, etc. List price $47.00. NEW. **Stock #302.**
Our price..... **$9.45**

HALES FIRE PUMP

For fire depts., Factories, forest fire prevention, etc. 600 gal. per min. Can be operated with a four or six cylinder gas engine. 4½" intake..... 2—2" outlets..... 265' head at 120 lbs. pressure. Passed by national board of fire underwriters. NEW. **Stock #407.** Price **$109.00**

MARINE FLOAT

Heavy rubberized fabric. ½" rope encircles raft passing through dee rings as handles. Can be used as wading pool, dock, raft, etc. Will support 4 ton and cannot tip. Used but like new.

6' wide x 20' L **$59.50**
6' W x 25' L **$69.50**
50% deposit to handle shipping.

HALF TON WAGON

Half ton wagon with plate aluminum body 24" x 42", ⅝" steel axle. **Stock #332.** Write for details.

RUBBER WHEELS

Good for boats, scooters, wheelbarrows, etc. **Stock #336.**
2.75 x 10⅝" & ½" bore..... **$4.80**
4.00 x 8⅝..... **$10.95**
10½ x 4, 6 ply ⅝..... **$8.95**
14½ x 5, 6 ply 1"..... **$10.95**

STAINLESS STEEL TABLE TOPS

Polished top dull bottom hardwood veneer center ¾" thick. Ideal for: work table, laundry tubs, shelves, back bar work board, etc. **Stock #411.**

22 x 19½"	11 lb.	$1.95
22 x 21½	12 lb.	$1.95
23½ x 27"	15 lb.	$2.45
22 x 29½"	16 lb.	$2.95
22 x 34	20 lb.	$3.45
22 x 37	22 lb.	$3.95

GENERATORS & AC ARMY LIGHT PLANTS • Light plants

300 watt. 110-220 Volt AC, 60 cycle light plant powered by 1 hp gas engine, direct drive. Mounted base weight 40#. **Stock #409.** **$99.50**
500 watt. 110 Volt AC, 60 cycle. Onan direct connected. **Stock #414.** NEW..... **$149.50**
NEW 800 to 1000 watt. 110 Volt 60 cycle AC plant with Briggs & Stratton directly coupled to a Leland generator. **Stock #351** **$179.50**
NEW 1000 to 1200 watt. 110 Volt 60 cycle. AC plant with Briggs & Stratton directly coupled to a Leland generator. **Stock #352** **$191.50**
2500 watt. 110 Volt AC, 60 cycle with Briggs & Stratton Model Z and Leland generator. **Stock #317.**
Used but like new..... **$225.00**
NEW **$295.00**
Add $10.00 for tools and spare parts
5000 watt. 110 Volt AC, 60 cycle with automatic remote control. Powered by 4 cyl Jeep gas engine. Used, like new.
Stock #318 ..... **$625.00**
7500 watt. 110 Volt AC, 60 cycle powered by a VE 4 Waukesha 4 cyl gas engine. Continental or Hollinsworth generator. Remote control starting. Complete with switchboard. Used but like new.
Stock #347 ..... **$675.00**
Add **$65.00** for transformer to make this plant 3 phase 220 volt.
10,000 watt. 110-220 Volt AC, 60 cycle. Remote control. Powered by a Jeep 4 cyl gas engine. Used, like new.
Stock #319 ..... **$900.00**
NEW job original crate only **$1100.00**
25,000 watt. 220 Volt AC, 3 phase. Spare parts. NEW packed for export.
Stock #415 ..... **$1995.00**

GENERATORS

300 watt. 12 Volt DC. 2000 RPM. Heavy duty with current cut out relay. High and low switch. 30 amp meter. Can be bought less shaft and base to be used directly mounted to a Briggs & Stratton 1 HP engine. **Stock #323. NEW only** **$7.00**
Complete with shaft, base and bearing. **Stock #324**..... **$15.95**
300 watt. 110-220 Volt AC, generator. Mfg. by Electric Specialties Co. Weighs 20#. **Stock #416.** New only.... **$34.50**
800 to 1000 watt. 110 Volt AC, 60 cycle generator with built in radio filter. Leland ball bearing 1800 RPM.
Stock #526 ..... **$79.50**
1000 to 1200 watt. same as above. 1800 RPM. **Stock #527**..... **$89.50**
2500 to 3000 watt. Leland generator, 110 Volt, 60 cycle, 1800 RPM. Self excitor, radio filter, junction box for plug in.
Stock #528. NEW..... **$145.00**
3000 watt. Delco, 110 Volt DC. Plug in, ball bearing 2800 RPM. List price $243.00. Used but like new.
Stock #321 ..... **$79.00**

ALL ITEMS GUARANTEED AS REPRESENTED

C & H ELECTRIC Co.
438 W. JUNEAU AVE.
MILWAUKEE 3, WISCONSIN

All prices F.O.B. Milwaukee. 25% deposit required on all C.O.D. orders. No C.O.D.'s under $10.00. Use stock number when ordering. Many other bargain items not listed—write for our free circulars.

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Picture yourself with a new Phantomold on your Beltone Hearing Aid. You're poised and relaxed even in group conversation. And no one need know you're wearing a hearing aid! See this newest hearing improvement. Look up Beltone Distributor in your local phone book. Or, mail coupon to Chicago for valuable free booklet.

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BUILD YOUR OWN TILTING ARBOR SAW!

SAVE $50 OR MORE

- 27x28 in. table stays level. Blade tilts full 45 degrees.
- 10 in. blade cuts 3 1/4 in. deep, jackscrew depth adjustment.
- Floor model, 34 in. table height.
- New Departure ball bearing arbor, 3/4 in. precision shaft, ready to run, 5/8 in. bore blades.
- Quick-positioning, self-aligning rip fence guide.
- Sturdy wood, steel and aluminum construction.
- No machining—build easily with hand tools only.
- Capacity and performance of floor saws selling for $150.00 and up!!

GIL-BILT Step-by-Step pictorial plans (No blue-print reading required), full scale patterns, 11 actual photographs $1.00
GIL-BILT Metal Parts Kit includes Plans, ball-bearing arbor, cast aluminum miter gauge and bar, rip fence guide, machined lock knobs, jackscrew mechanism with 4 1/2 in. handwheel, and all other metal parts including every screw, bolt, nut and washer (less blade) $20.95
Same Kit with 10" combination blade 25.90
Same Kit with 8" combination blade 24.90
Return in 10 days for full refund if not satisfied.
(Prices include postage up to 600 miles)
Also available—Plans and Metal Parts Kits for 8" Tilt/Table Saw and 12" Band Saw. Order Plans at $1.00 each—sent postpaid anywhere in the world, or write for FREE descriptive Catalog.

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DISCOVER URANIUM
and Other Valuable Radioactive Ores!

Advance orders being taken for "URANIUM PROSPECTING" by Victor Shaw. A prospector's manual—tells where and how to look, what to look for, etc., $2.00 per copy.

The TX-8 GEIGER COUNTER—a superior instrument for locating deposits of radioactive ores. Compact, light weight, simple to operate, rugged. Extra sensitive—locates the ores and estimates the quantity and quality—right in the field. Made by world's largest exclusive manufacturers of Geiger Counters for prospectors.

Write for details and prices

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DEPT. 6, 3601 N. 24th St., OMAHA 10, NEBR.

30" SHEET METAL BRAKE

Forms angles, channels, vees, flanges, locks, zees. Handles 26 gage sheet steel, heavier gages of aluminum, copper, plastic, etc. Portable. Can be held in a bench vise, or bolted down. All steel. Wt. 40 lbs. Shipped exp. collect.

$24.50

12" BRAKE. Fits in vise to form difficult and compound bends, up to 20 gage steel 12" wide..... $12.50 PP.
SHEAR. Cuts 16 gage steel any length and width. $12.50 PP.
SHEET METAL PLIERS. 2 1/2" wide. $2.00; 3". $3.50.
Immediate delivery. Order direct, cash or C.O.D., or send for folder.

VISE BRAKE MFG. CO.
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DUMORE Duplex Grinder Makes work faster, easier, twice the fun!

Do *more* in metal, wood, and plastics! A Duplex gives you extra power, chucks three different tool sizes, converts for flexible-shaft, bench, or lathe work. It's a honey.

Write for Free folder.

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HIGH POWER TELESCOPE

60 POWER-ALUMINUM TUBES-OPENS TO 33"

Variable Power Eyepiece Adjustable to 15X, 30X and 60X.

$4.50

Leather Case Included

5 Sections. 4 Lenses. Also used as 50X Microscope. Money Back Guarantee. Only $4.50 POSTPAID.

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ZIRCONS

Loose. Genuine Siam Imports. Pure white. Special: 3 Genuine Zircons, from 1/2 kt. to 1 1/2 kts. 3 gleaming gems $6.00 tax included. We can supply Zircons in all sizes and mountings of all types. Send order or write for details today.

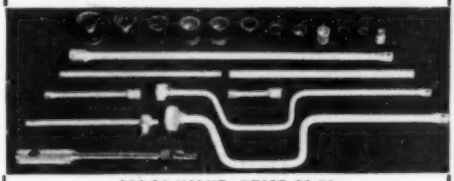
B. Lowe, Dept. PS, Holland Bldg., St. Louis, Mo.

NEW 1949
Plastics Supplies Catalog

Just off press. Full details on Plexiglas, Lucite, rods, sheets, tubes. Acetates, cements, dyes, buffs, molding sets, tools, carving kits, accessories. Everything in plastics. Gives prices, sizes, colors, etc. Price 10c, stamps or coin, with ad for catalog.

PLASTICS MFG. & SUPPLY CORP.
Dept. PS-6 4707 Euclid Ave. Cleveland 3, Ohio

SOCKET SET



$20.00 VALUE—PRICE $9.50

Our purchase of over 200,000 wrenches as unused U. S. Air Force surplus makes this low price possible. All tools are NEW. All sockets are 12 point and plated. They are well-known popular standard makes such as Plomb, Snap-On, etc. Set consists of 22 pieces, 1/2" and 3/8" drive. Shipping weight 10 pounds. This is what you get.

1—5/16" Socket	1—13/16" Socket	1—2" Extension
1—3/8" Socket	1—7/8" Socket	1—4" Extension
1—1/2" Socket	1—15/16" Socket	1—18" Extension
1—9/16" Socket	1—1" Socket	1—T Handle
1—5/8" Socket	1—1 1/16" Socket	1—1/2" Flex Handle
1—11/16" Socket	1—1 1/8" Socket	1—3/8" Speed Handle
1—3/4" Socket	2—Bar Handles	1—1/2" Speed Handle

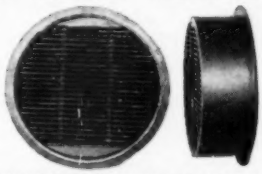
All sets shipped via parcel post same day we receive order.
Money Order or Check, 25% Dep. on C.O.D.'s.
Prices F.O.B. Fresno.

ARMY SURPLUS SALES OF FRESNO

1820 TULARE ST. FRESNO, CALIF.

DARK ROOM VENTILATORS

13 1/2" DIAMETER



4 1/2" THICK • STEEL

VENTILATE YOUR DARKROOM

$25.00 Value—PRICE $7.50 set or $4.00 Each

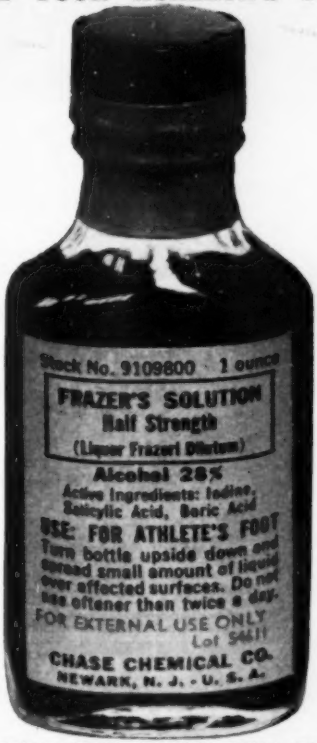
New government surplus. Air flows through these steel louvers freely due to the arrangement of baffle plates. Light does not show through these ventilators. Hundreds of these vents have been installed in darkrooms. You will need two for your darkroom. Install one in or near the ceiling and one near the floor. $7.50 for set of two, or $4.00 each.

Pay by Money Order or Check, 25% dep. on C.O.D.'s. Prices are F.O.B. Fresno. Shipping weight 29 lbs. for set of two.

ARMY SURPLUS SALES OF FRESNO

1820 Tulare Street Fresno, Calif.

KILL YOUR ATHLETE'S FOOT



ATHLETE'S FOOT KIT 50c

Famous Frazer's Solution used by the U. S. Army all over the world. Kit consists of one bottle Frazer's Solution and two packs of Scholl Foot Powder. All orders filled the day they arrive—**we pay postage.** Do Not Delay! Mail Your 50c Today!

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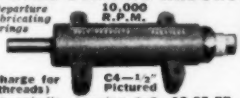

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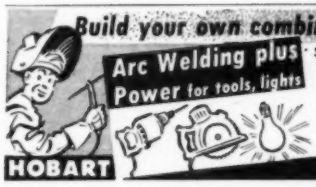

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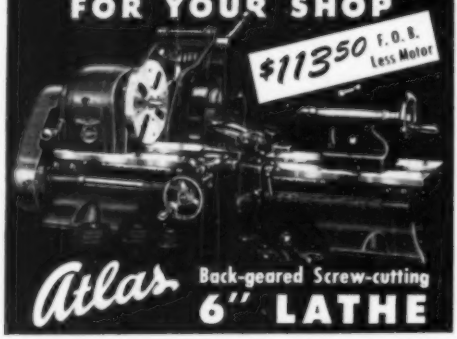

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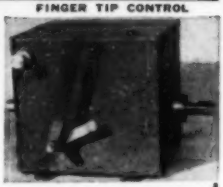

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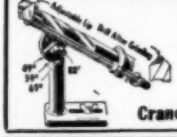

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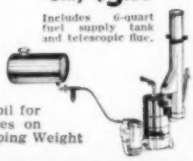

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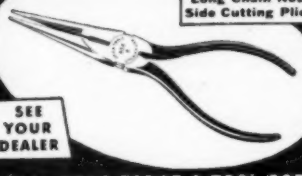

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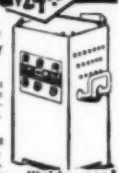

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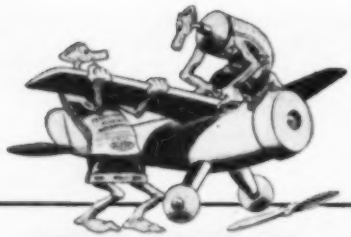

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For 40 years Kermath has produced the largest range of

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Gasoline—5 to 550 H.P.—1 to 12 Cylinders
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ALL NEW MERCHANDISE!
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TIME-SAVING TOOLS for SHOP and HOME

DREMEL ELECTRIC POWER TOOLS

OWN A FAMOUS MOTO-TOOL

The "Pocket-Size Machine Shop"

HIGH-SPEED STEEL CUTTERS —AT NO EXTRA COST

No shop or home is completely equipped without **MOTO-TOOL** . . . the **correctly balanced** motor-in-hand tool. It grinds, drills, carves, polishes—**without vibration.** 27,000 r.p.m. (approx.) does work better, faster, in wood, metal, glass, plastic. **MOTO-TOOL Kit No. 2** includes **high-speed steel cutters** for longer life. **MOTO-TOOL** is backed by over 12 years of industrial use . . . packs years of pleasure. Due to wide popularity and increased production, **Dremel's pre-war prices still prevail!**

Approx. 27,000 R. P. M.

MOTO-TOOL KIT NO. 2 with 23 accessories including **high-speed steel cutters** and Model 2 Moto-Tool in hardwood case . . . **$23.50**
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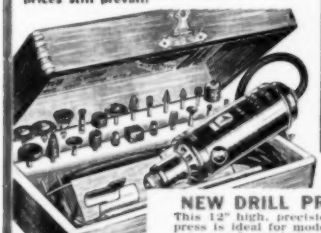

NEW DRILL PRESS

This 12" high, precision drill press is ideal for model making, wood carving, routing, etc. Utilizes No. 2 Moto-Tool. **Only $9.95 (Less Moto-Tool).**

Look For These Moto-Tool Features

Dynamically balanced armature for vibrationless finger-tip control ● Oilless (oil-sealed) bearings ● Patented automatic chuck lock pin ● Over-size armature shaft—hardened, ground, polished ● 110 Volt AC-DC motor ● Snap-type sliding switch ● Cord protector ● Shockproof bakelite housing ● Dust-filtered air-cooling system ● Weighs only 13 oz.

NEW ELECTRIC "MOTO-SANDER" AND POLISHER

Makes Fun of Hard Work

Patented

Only $14.85 POSTPAID

SAY "GOOD-BYE" TO HAND SANDING & POLISHING!

Let speedy **"Moto-Sander"** do the work while **you** just guide it. Ideal for light sanding jobs. Use **Moto-Sander** for finishing, refinishing, redecorating. Quickly and smoothly sands furniture, walls, woodwork, wall board, plaster joints; boats, workshop projects, etc. **Straight-line action (non-rotary) will not burn or scratch surface.** Use **Moto-Sander** also for fast, effortless **polishing** of furniture, refrigerator cabinets, automobiles, other waxed surfaces. This versatile machine works on flat or curved surfaces—gets into tight corners. **Moto-Sander** is the lightest, most practical electric sander on the market. Delivers 7,200 strokes a minute . . . weighs only 2½ lbs. Furnished complete with 6 sheets assorted grade Garnet Paper for sanding, plus **felt pad** and **sheepskin** for wax polishing. Operates on 110-120 V., 60 cycle A. C. Thousands of satisfied users.

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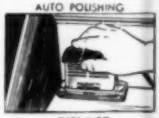

GETS INTO TIGHT CORNERS

MOTO-SAW

AN *Electric* SCROLL SAW

SAFER THAN A HAND SAW

A high-speed power saw for boys from 8 to 80! **Moto-Saw's** 7,200 strokes a minute easily cuts intricate scroll designs—no limit to length of cut—averages 1 foot per minute through medium hardwood up to ¾" thick. **Four-way blade holder** permits sawing in any direction . . . at any angle. **Moto-Saw** has only 2 moving parts—never needs oiling. Operates on 110-120 V., 60 cycle A.C. Thousands of satisfied users.

ONLY $5.85 POSTPAID
(With 3 Blades)

JUST GUIDE IT!

The versatile **Moto-Saw** is as safe as a hand saw. A touch of the trigger switch sets it going . . . releasing stops it instantly.

WHERE TO BUY:

Buy Dremel Tools from your dealer. If he cannot supply you, send **full purchase price** (check or money order) and we will ship **postpaid.** Or, send only **$2.00** now, and pay postman balance plus postage upon delivery. **Your Money Back** if not delighted after 5 days' trial.

DREMEL MFG. CO.
Dept. 129-F Racine, Wis.

HIGH PRESSURE HYDRAULIC PUMP

FOR HOME, SHOP AND FARM USE

Genuine Vickers constant displacement high pressure pump. Use it for any type of liquid pumping job. Will pump 400 gal per hour at 1750 R.P.M. Precision piston type design provides 1000 lbs. per square inch pressure. Self priming. Standard thread ¾ inch intake and discharge ports. With ⅝ inch splined shaft—just add pulley and power and you're ready to go.

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These pumps are brand new. Original acquisition cost approx. $100.00. Can also be used as hydraulic motor; for rams, opening doors, hydraulic lifts, etc. also for any liquid transporting job. War surplus, but brand new. Shp. wgt. 7 lbs. Will include at no extra charge an hydraulic control valve and ship postpaid when remittance accompanies order. (Control valve, only $1.95.) Satisfaction guaranteed. Rush your order today.

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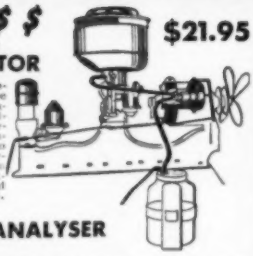

$21.95

Burn cheaper gasoline, yet get more power, a cleaner engine, amazing acceleration. Injects a metered quantity of water and alcohol into carburetor during acceleration. Simple to install. Pays for itself in service and fuel savings. **$21.95.**

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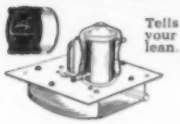

Tells right on the dash whether your engine is running rich or lean. Available in 12 and 24 volt units. Can be used with B Batteries for pleasure cars. Saves fuel. A money saver for truck operators. Each **$9.95**

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0 to 2000 lbs. pressure, luminous dial, plastic body 2¾" square mounting, 2¼" base diameter Each..... **$2.00**

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Complete with end fittings. All sizes, all lengths. Write for catalog and price list.

24 VOLT SOLENOID SWITCHES

Can be used as magnetic contactors or current relays. Each **$1.00**

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Three single pole, double throw switches, 1 micro switch, 1 light and 1 shutter, mounted in plastic box 3½" x 3" x 1¾". Each..... **$1.00**

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WORLD'S LOWEST PRICED CAR

Drive this car for as low as 50c per week. Up to 90 miles per gallon. 45 to 50 m.p.h. Large enough for a husky six footer. A pleasure to assemble. Just bolt together our precision built parts. Get the facts. Send 25c for detailed circular with large photo, 4 view drawings, price of all parts. Better still, send $1 (refunded first order) for this plus actual assembly book with 42 photos, drawings, blueprints of snow and ice conversions, etc.

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Save Money—build your own Smith Air Compressor! Famous the world over! Capacity 60 cu. ft.; pressure up to 100 lbs. per sq. inch. Just order the Smith Compressor Head and Accessories with complete instructions for assembling. All you need is a Ford Motor and shop facilities. Head equipped with high speed compressor valves; automatic unloading and idling.

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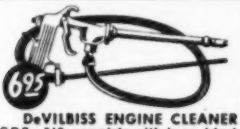

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Cleveland 16 or E3, or Chicago 3X, Pistol Grip. Used. Cost government $55.00. Your cost, only $6.95 ea. Includes one set and spring. Extra sets, 35c.

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For screws ¼" to ½" inclusive. Drills, drill guides, extractors & turnuts. 21 precision pieces and case. Brand new. $12.00 value, $6.95.

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Wedge type like Plomb, ¼ to ⅝ capacity, ½" drive. New. $3.00 value for only $1.15.

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Hvy. duty, all-steel, 12½"/18½".....$2.75 pr.

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Please add sufficient postage
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"I had three water pipes with bad leaks. Being an expensive amount of work to be done, I decided to try TIP-TOP. I took a part of a tube of TIP-TOP LIQUID SOLDER and fixed those pipes in a few minutes. It's been seven months now and they are still under our high water system."

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I am interested in your offer. Please send me full information.

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Does jobs no other tool can do. Double-lever action LOCKS jaws with tremendous grip—quickly adjusts to non-locking action. **New Involute Jaw Curve** holds all shapes—nuts, rounds, irregular shapes, with unbelievable ease. Has **Knurled Jaw Tips** that do not slip. **Thin Nose. Super Wire-Cutter. New geometry** gives more power—easier opening. Fine alloy steel. Nickel plated finish.

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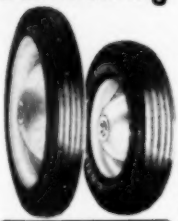
PETERSEN MFG. CO., Dept. E-6, DeWitt, Nebr.

Ball-Bearing SPEED WHEELS



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Juvenile Wheels
(No bearing, solid tires)

5" .....45¢ 6" .....65¢
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(Semi-pneumatic tire, ball bearing)

8 x 1.25	1.85	10 x 1.25	2.20
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5 x 1.75 Belted	3.65	10 x 2.75 HC	5.70
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8 x 2.00	5.20	4.00 x 8-2	14.70
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10 x 2.00	6.10	16 x 4.00	15.15

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Above wheels painted red

10" cast alum. wheel, 2 3/4" semi-pneumatic tire, 5/8" ball bearing	$4.50
Hub caps for 5", 6", 7" wheels	3¢ each Plus postage

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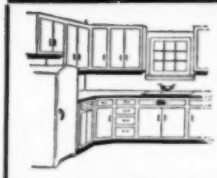

SAVE 2/3 THE COST!

New, illustrated manual shows every step in easy-to-understand charts and directions. How to modernize for yourself and get "professional" results at 1/3 the cost. Includes free design for your kitchen, plus net factory costs on knock-down cabinet fronts and other items. Have fun modernizing your own kitchen and save 2/3. Mail $1.00 for complete kit to—

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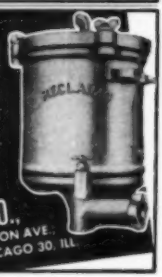

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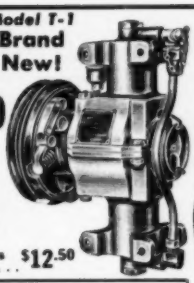
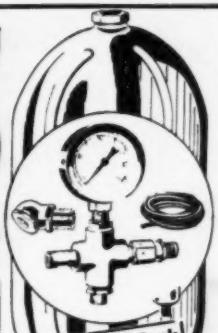
"Wellworth" Sensational Offer! Reg. $60.50
WESTINGHOUSE AIR COMPRESSOR

Model T-1 Brand New!





plus pressure tank, air gauge, air chuck, 20 ft. hose, pop valve, and fittings as shown.

COMPLETE OUTFIT OF 6 ITEMS ONLY

$31.50

Compressor Separately $21.50

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This low price is but a fraction of the price of manufacturer and of leading mail order houses.

THE COMPRESSOR

Piston Type, 2-cylinder, 2 inch bore, 1½" Stroke Ball Bearing AUTOMATIC CLUTCH, OIL FREE AIR, 3.27 C.F.M. at 600 R.P.M., 6.54 at 1200. Suggested operating pressure 75 P.S.I. DIMENSIONS: 9" wide, 11⅛" high, 6⅝" deep. Wt. 26 lbs.

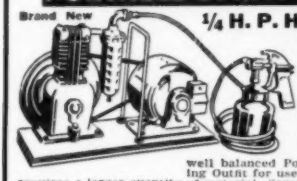
TANK and ACCESSORIES

12" x 24" stainless steel tank suitable for 150 lb. pressure. Two ¼" openings. Air gauge, pop valve, air chuck, 20 ft. hose and fittings as shown.

12" x 24" Tank Stainless Steel Capacity 12 Gal.

PORTABLE SPRAY OUTFIT

Brand New



¼ H. P. HEAVY DUTY

Compressor only . . $17.50
Compressor and filter . . $19.50
Spray gun and hose . . $10.45
Adj. ¼" pop valve . . . $1.50
2½" Air gauge . . $1.75

well balanced Portable Spray Painting Outfit for use where painting job requires a larger quantity of material. Sprays all types of average viscosity paints, enamels, lacquers, varnishes, etc. Piston type, single cylinder air compressor has 2 in. bore by 1¾ in. stroke. Displacement 2.86 C.F.M.; maximum working pressure 40 lbs. Mounted on sturdy wood base with rubber feet attached. Pulsation chamber is equipped with safety valve, drain cock, ¼ H.P. motor, 110-volt AC, with cord and plug; 20 ft. air hose and fittings. Spray Gun is pressure feed type, internal atomizing, with one quart metal cup. Fan and round spray nozzle furnished. Shipping Wt. 50 lbs.

$45.00

Same Outfit, less motor, $35.00

AUTOMATIC COMPRESSOR UNIT

Save $50.00

1.3 H.P. heavy duty capacitor motor AC 110/220 volt 60 cycle, 2 x 1¾ inch piston type compressor, splash feed lubrication, 12 x 24 inch tank, automatic pressure switch, pressure range 100 to 125 lbs., check valve, safety valve, air regulator with gauge and filter, 20 ft. air hose with air chuck for inflating tires, V. belt drive. Shipping wt. 90 lbs.

Special Price $79.50

Same unit as above with 1½ H.P. motor, furnished with 13" x 24" tank. Shipping wt. 125 lbs. $98.50

"Wellworth" Two Stage COMPRESSOR UNIT

Ideal for paint spraying and general use. Compressor: Size 3½ & 2 x 2½ with unloader for continuous pressure service; displacement 10 C.F.M. at 200 lbs. pressure. Unloader set at 150 to 165 lbs. Compressor idles when 165 lbs. is reached, starts pumping again when pressure is down to 150 lbs. Wisconsin Gasoline air cooled, easy starting engine 3½ H.P. at 1800 R.P.M. 4.1 H.P. at 2400. Air Tank; A.S.M.E. 200 lbs. working pressure; size 16" x 29" with safety valve, drain, two ⅜" globe valves and pressure gauge, 2 "V" belts and pulley, 40 ft. air hose and fittings. Wt. 350 lbs. Reg. price $400, less base.

$225.00

Price of compressor with unloader, wt. 160 lbs. $128.00
Price of engine only, wt. 90 lbs. 87.50
Price of tank and accessories, wt. 110 lbs. 62.50

300 GAL. COOLANT PUMP

A HEAVY-DUTY PUMP AT 40% LESS

You pay less and get a larger, higher pressure, higher capacity, heavy duty coolant-type, recirculating pump. Also extensively used on evaporative coolers. Will deliver 60 gal. per hr. at 8 ft. head and 300 GPH at no head. Heavy duty 1/30 H.P. totally enclosed, 110V., 60C. motor with long life oiling. Non-corrosive shaft and pump. 10½" high, ⅜" I.P.T. Shipping weight 12 lbs. .....

$19.50

140 CFM "WELLWORTH" BLOWER

Single-inlet blower that gives top performance on heating, ventilating, exhausting, cooling, drying and similar applications. 5⅛ x 4" mounting flange with 2½" square discharge, 3½" dia. blower wheel powered by direct-connected 1/15 H.P., 110V., 60C., A.C. motor with conduit box and 20" leads. 7½" wide less flange by 7¼" H. x 6¾" D. Suited for hundreds of new and replacement uses. Shpg. wt. 6 lbs... **$16.50**

"Wellworth" Check Valves

¼" valve $2.75
½" valve $4.50

6 FT. STOW

FLEXIBLE SHAFT

Heavy Duty. ⅜" Core. Best piano wire. Ball bearing handle and arbor, rubber covered housing; for ½" motor shaft; for ½" bore wheels. Operates on ¼ H.P. Motor at 1725 or 3450 R.P.M. $29.00 Value. **$14.50.** Wt. 8 lbs.

Reduced Price **Only $14.50**

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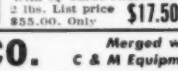
Chicago Pneumatic Riveter & Chipping Hammer

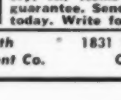
CP4X Pistol grip handle with air control. Takes up to 3/16" rivet. Weight 6 lbs. List price $73.00.

Special Price $14.50 | **Same, as above, brand new $22.50** | **Size CP3—Takes 5/32" Rivet $10.95**

A.V.C. 11 INGERSOLL RAND



Push button, takes 5/32" rivet. Wt. 3 lbs. List price $65.00. Only **$10.95**



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Used by Electricians, Sheet Metal Workers, Plumbers, Painters, Radio Repairmen, Plastics Workers, Auto Mechanics — Body Repair Men, Dental Technicians, Printshops, Neon Glass Workers, Laboratory Technicians of All Kinds, Home Workshops — Hobbyists. All these use it for many varied purposes.

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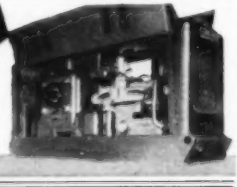

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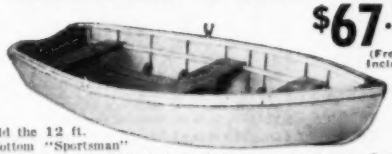

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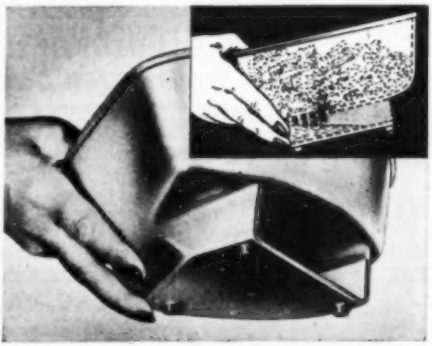

Strainer Is Dripless. A separate compartment beneath this strainer catches drippings to keep them off the kitchen floor when carrying the strainer to the garbage pail. It's made of a single piece of plastic that will not bend or distort in hot water. Made by the All-Power Mfg. Co., Montebello, Calif., it's priced at about 70 cents.

Modern Living

Crank Raises Broiler. The broiler of this new range can be raised or lowered without opening the oven door. Turning a crank on the door operates the grill like an elevator to adjust it. The maker is the Supermatic Products Co., Burbank, Calif.

Covers Adjust to Bowl Size. Adjustable to bowls from 3" to 8" in diameter, these plastic bands have two rows of perforations into which snap buttons fit. After adjustment, a sheet of disposable plastic is laid over the bowl and the band pressed in place. Fastop Sales Corp., New York City, markets four bands and 24 sheets for $1.

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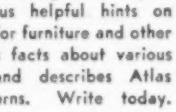

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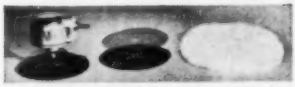

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TO: Reader
FROM: Editor

The Editor Takes His Medicine

Official U.S. Navy photo aboard U.S.S. Sicily

Aboard flagship of Hunter-Killer Force, l. to r.: Comdr. D. R. Mallinson, Royal Navy; Perry Githens, PS; J. M. Minifie, N. Y. *Herald Tribune;* Rear Adm. T. H. Robbins, Jr., USN.

EVERYBODY on POPULAR SCIENCE, from Editor to newest editorial associate, has to do some original writing to keep his viewpoint fresh and his humility healthy. When an editor turns writer, as often happens, his work gets extra scrutiny from the staff.

That leads to some funny situations. The head of the copy desk traditionally is the man who slashes stories to pieces—or so the writers insist. So when the head of the copy desk becomes a reporter, he knows that his stuff is due for a good pencil-drubbing. The copy of the managing editors gets especially thorough, solicitous treatment when they elect to write an article themselves.

But the roughest going-over is reserved for the stuff that comes out of the typewriter of the Editor himself. That is only fair, we think. Our man Githens is very quick to question with red pencil the writing of both staffers and contributors.

So it was with somewhat indecent glee that we watched when he assigned himself to do the story on submarines (pp. 98-105). He said it was simply because it was easier to do it himself than brief somebody else for the chore (true). He claimed he was one of the very few observers who had been both downstairs in subs and upstairs looking for subs during World War II (true). He said it was a tough assignment anyway, and that he didn't expect to enjoy himself (false!). So we let him go to New London.

If he winced under the barrage of criticism and questions after the article had made its second tour of the shop, nobody could detect it. It must be entered in the record that he sat down and rewrote it.

Then he decided he had to see the other side of the picture: the Navy's big fleet problem in the nice, warm Caribbean.

It was a happy coincidence that the skipper of the carrier of the Hunter-Killer Force happened to be Captain Robert B. Pirie, USN, who had been executive officer of the USS *Mission Bay*, first Casablanca-class jeep carrier to operate in the Atlantic, on which Githens was the only war correspondent.

So our Editor, accompanied by the *New York Herald Tribune* correspondent, James MacDonald Minifie, managed to detach himself from the Big Show you read about and get aboard the USS *Sicily* during the ASW (Anti-Submarine Warfare) operations.

Now Githens, who had been dunking with the fox in a submarine a few days earlier, had a chance to run with the hounds. Only, he says, it isn't fox and hounds any more. It's fox and fox: the ASW men have had to become as wily as the submariners.

Day and night, the subs and the hunters worked each other over. A sub "sank" the *Sicily* one day. The Hunter-Killers caught a sub another time close by the *Sicily*. Githens got a big bang out of this: it was the *Tusk* he had just left in New London.

Next morning our Old Man boosted his bulk into a blimp for several hours of ASW patrol and started the trip home.

The look that he gave his staff on his arrival was an odd mixture of the bellicose and the sublime. It said: "Hoped that I'd fall flat on my face on my assignments, did you!"

The Staff

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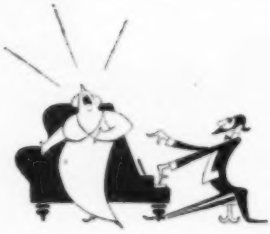

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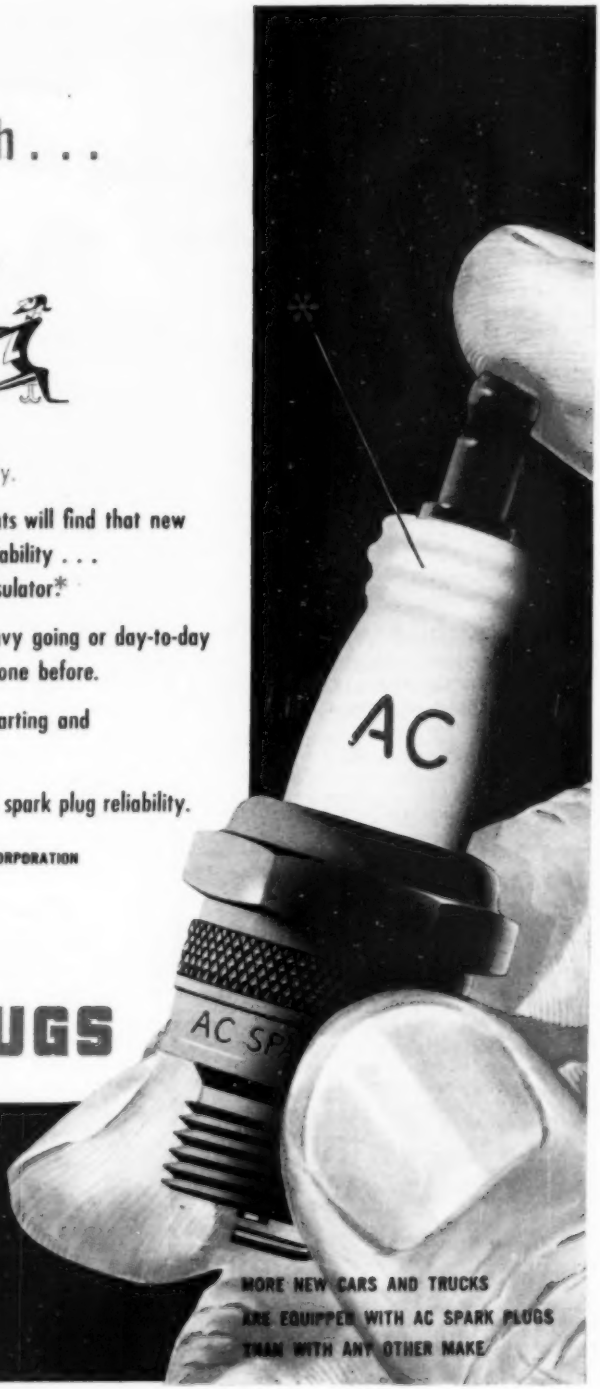

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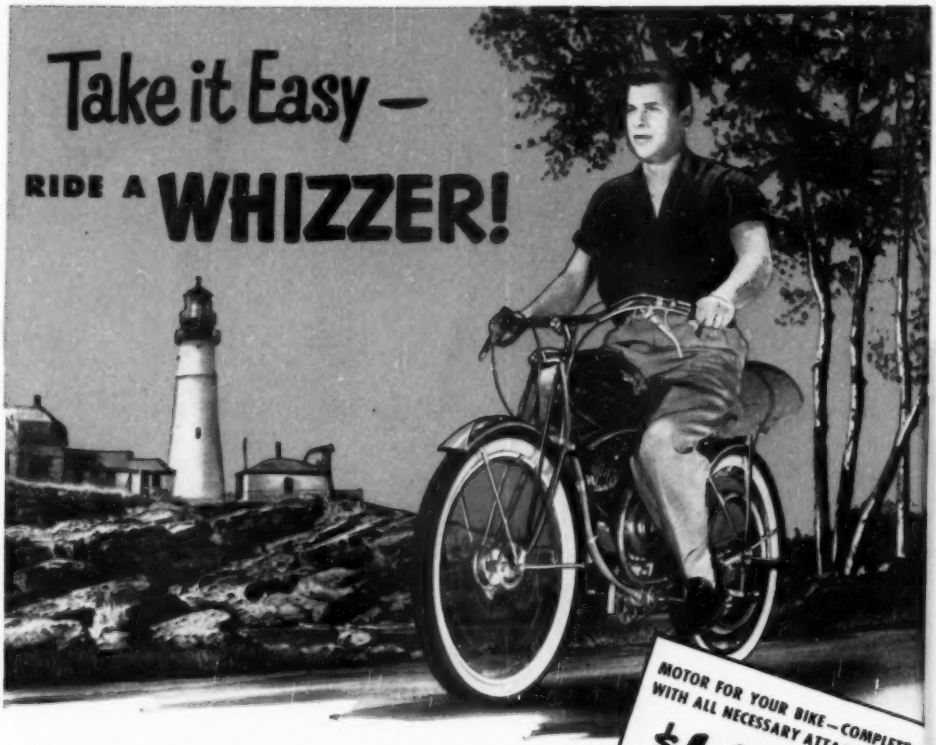

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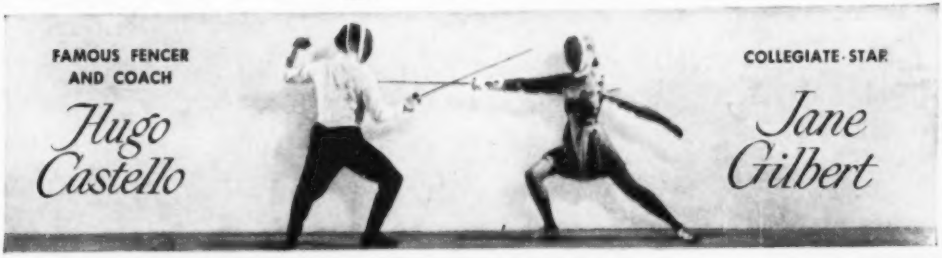

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